TECHNOLOGY DEPT.

THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

Vol. 31, No. 4, April 1952

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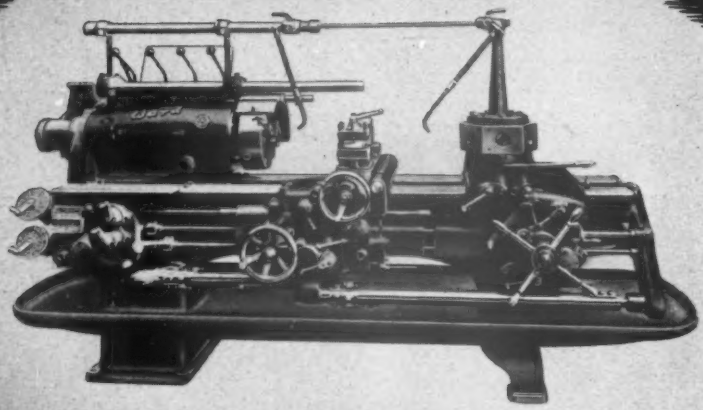

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Spindle: Mounted in ball and roller bearings.

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17 in. SWING
'JUNIOR'
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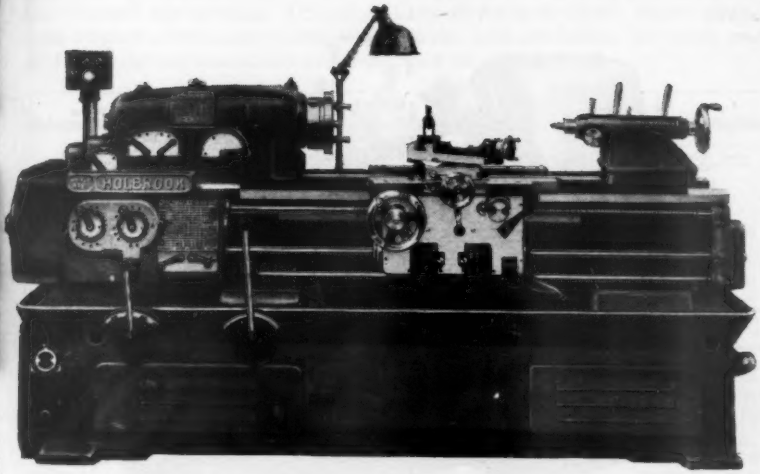
HIGH-SPEED PRECISION LATHES



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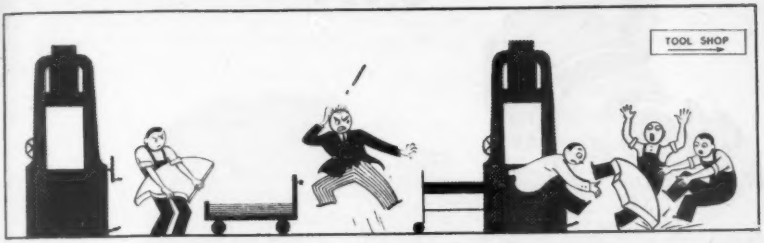
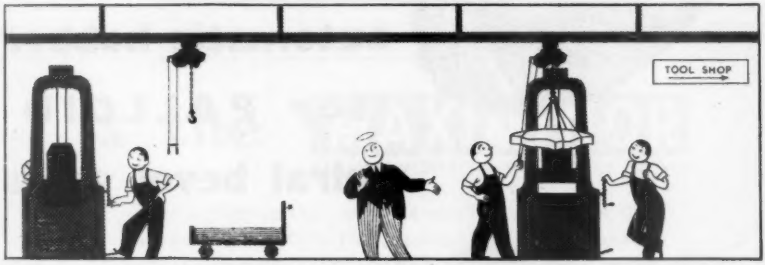
Everything happens in *some* factories



(Above) **IDLE MACHINES,** avoidable fatigue and accidents are part of the real cost of out-of-date handling. It tends to make its mark in the balance sheet when goods are heaved and humped about by hand.

(Below) **WHAT A DIFFERENCE** when lifting and shifting are *organised*, part of a smooth production flow! Nearly always it means more production, less effort, lower cost per unit.



YOU'RE PAYING FOR A MODERN HANDLING SYSTEM whether you have it or not! Replace all the humping and heaving with modern materials handling gear and you save all along the line. A well-planned installation quickly pays for itself and goes on saving time, money and effort year in year out

Your problem is 'different'? Many of the most successful KING installations have been designed to fit a specialised need, from the sixteen miles of KING conveyors in the new Austin plant to small runway layouts.

You will find in KING booklets many useful ideas about Overhead Conveyors, Floor Conveyors, Travelling Cranes, Electric Pulley Blocks and Runways. Look into this; there's no obligation except ours—to help you speed output and cut costs.

Here is a KING Dual Conveyor on the job in a famous nut and bolt factory. Note the special tip-bins.

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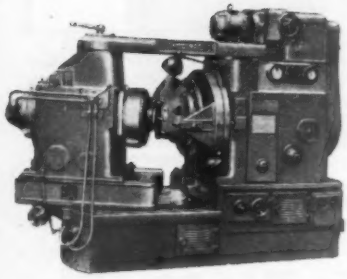

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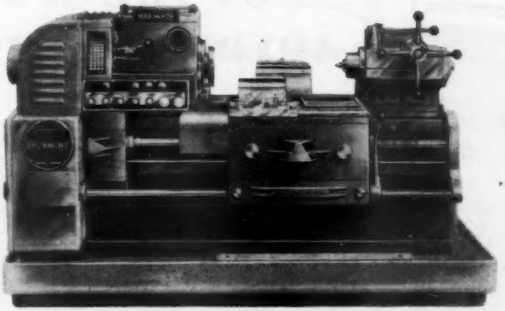

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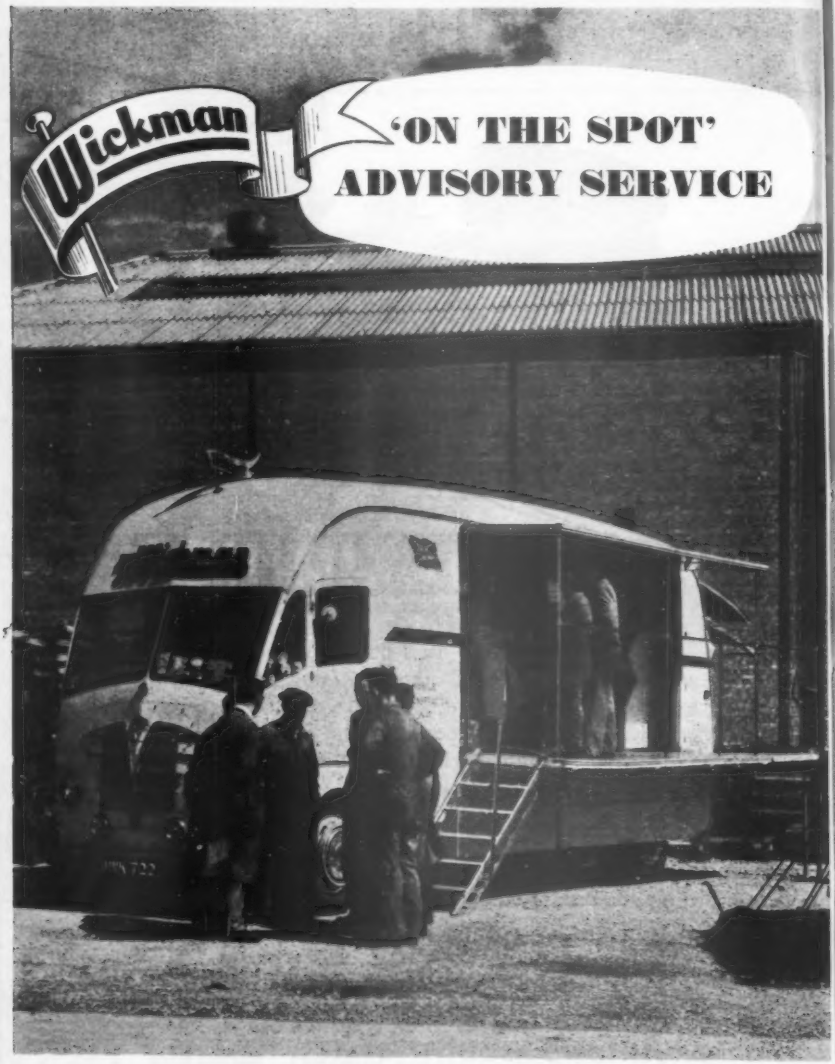

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The greatest productivity from carbide tooling can only be obtained when operators know the right grade to choose, the right time to withdraw tools from use for reservicing, the right wheels and methods—in fact, the right carbide technique.

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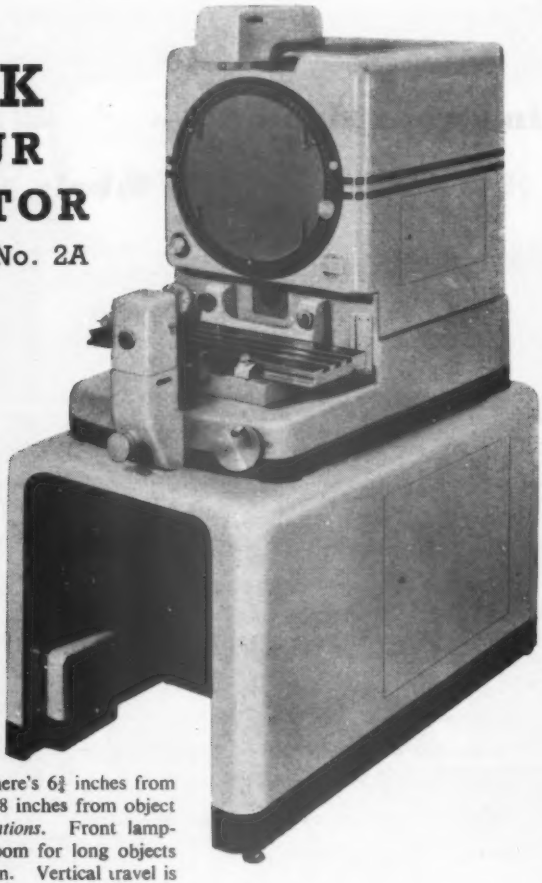
KODAK
CONTOUR PROJECTOR
Model No. 2A



Handles large parts. There's 6¾ inches from lamphouse to object and 8 inches from object to lens—*at all magnifications*. Front lamphouse pivots to make room for long objects under surface illumination. Vertical travel is 4½ inches.

It gives surface illumination in any of 5 planes, and switches instantly from surface illumination to silhouette projection, or to a combination of both. Instant dialing to any of 6 magnifications from 10X to 100X without distortion. The 14 inch screen is extra bright; no hoods or curtains needed—even in fully lighted rooms. Designed for all-day operator comfort, yet built to precision toolroom standards.

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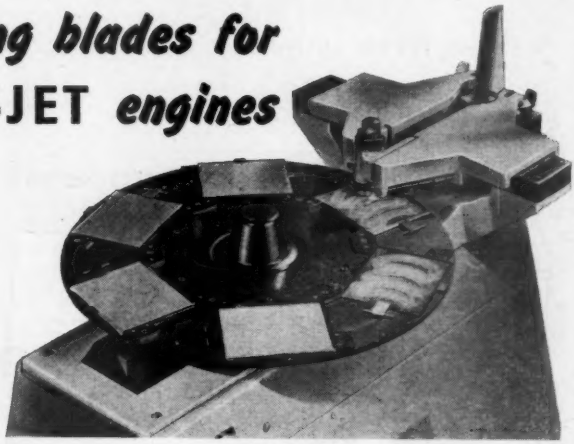
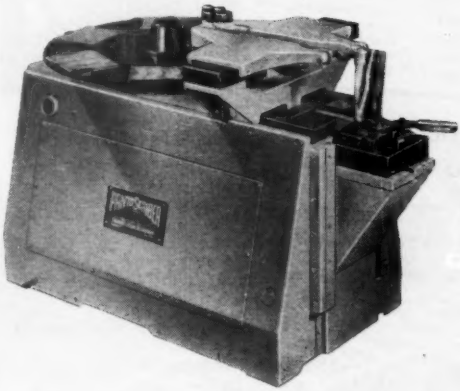
Inspecting blades for TURBO-JET *engines*





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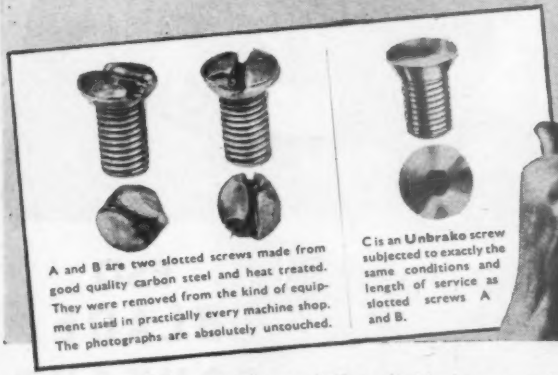
Take three screws . . .

treat them alike . . .

and look what happens!



A and B are two slotted screws made from good quality carbon steel and heat treated. They were removed from the kind of equipment used in practically every machine shop. The photographs are absolutely untouched.

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THE JOURNAL OF

THE INSTITUTION OF PRODUCTION ENGINEERS

Vol. 31, No. 4, April 1952

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INSTITUTION NOTES

April, 1952

COUNCIL ELECTIONS 1952/53—NOMINATIONS

(a) In accordance with Article 35, nominations are invited to fill six vacancies for elected members to serve on Council for 1952/53 (i.e. five Members and one Associate Member).

(b) Candidates for election must be nominated in writing by three Members or Associate Members of the Institution.

(c) In addition to nominations as in (b) each Section Committee may nominate one candidate.

(d) NOMINATIONS MUST REACH THE SECRETARY AT 36, PORTMAN SQUARE, LONDON, W.1, NOT LATER THAN 15th APRIL, 1952.

N.B.—Before candidates are nominated for election, their consent should be obtained.

The retiring members of Council, who are willing to stand for re-election, and who do not need nomination, are as follows:—

	Attendances at Council	
Members:—	*Possible*	*Actual*
A. J. Aiers	7	5
B. H. Dyson	7	4
B. G. L. Jackman	7	5
H. J. Swift, O.B.E.	7	1
Associate Member:—		
J. E. Burnett	7	6

Awards for Study in the United States of America

The Ministry of Education, the Scottish Education Department and the Ministry of Education for Northern Ireland propose to offer the following awards in 1952:

(1) About 35 post-graduate awards for the study of Production Technology and Management. These are available to students who have graduated with a good honours degree in either pure science or technology and who have had at least two years' industrial experience.

(2) Forty awards for the study of Management. Applications for these awards are invited from persons of adequate educational standard who are potential managers or occupying positions of responsibility in industry or who propose to teach management

subjects and are between 23-25 years of age. A minimum of three years industrial experience will be a condition of entry. Full details together with application forms may be obtained from: The Ministry of Education (F.E. Division 1), Curzon Street House, Curzon Street, London, W.1 or, in the case of candidates resident in Scotland or Northern Ireland, from the Scottish Education Department (T Branch), St. Andrew's House, Edinburgh, 1, or the Ministry of Education for Northern Ireland, Netherleigh, Massey Avenue, Stormont, Belfast, respectively.

All applications must be returned to the address from which the forms were obtained not later than 16th April, 1952, in the case of the awards mentioned in (1), or 30th April, 1952, in the case of the awards referred to in (2).

I.I.S. REPORT TO INDUSTRY

The Institute of Industrial Supervisors, which was founded in 1948 with the object of improving the efficiency of industrial supervision, has recently issued a brief Report of their activities during the past three years. The Institution of Production Engineers warmly congratulates the I.I.S. on its fine progress and widespread activities, particularly their contribution to education and learning.

Copies of the Report may be obtained from the General Secretary, Institute of Industrial Supervisors, Bank Chambers, 47, Temple Row, Birmingham, 2.

NEWS OF MEMBERS

Mr. J. D. Abbott, Associate Member, has joined the Test House Equipment Co., Ltd., Crawley, as Works Manager.

Mr. R. A. Cox, Associate Member, has taken over as Manager of the Hillington Branch of Guest, Keen & Nettlefolds (Midlands), Ltd.

Mr. B. H. Dyson, Member, who, until recently, was Deputy General Works Manager of Hoover Ltd., has been appointed General Works Manager for the four main factories of the Company. In addition to holding this responsibility for the whole organisation, he is a Director of Hoover (Washing Machines) Ltd. Mr. Dyson is a Member of Council of this Institution, and is also Deputy Chairman of the Research Committee, and Joint Chairman of the Joint Committee on the Measurement of Productivity.

Mr. J. Evans, Associate Member, is now a partner in the firm of Weston, Evans & Co., Production and Management Consultants, Birmingham.

Mr. R. E. Harrison, Member, is now General Manager of A. Bevey Stock & Co., Ltd., London.

Mr. E. D. Johnson, Associate Member, has joined Vauxhall Motors, Ltd., as a Technical Instructor in the Education Centre.

Mr. A. W. H. Lamond, Associate Member, is now Chief Accountant of British Cellophane, Ltd., Bridgwater.

Mr. J. W. Messinger, Member, has been appointed a Technical Adviser with the United Africa Co., Ltd., in West Africa.

Mr. H. F. Nutt, Member, has taken up an appointment as Factory Manager at Remploy, Ltd., Birmingham.

Mr. S. G. Paddick, Associate Member, is now teaching full-time at the Tunstall Technical School.

Mr. J. W. Powell, Associate Member, has been appointed Assistant Works Manager of Universal Jig & Gauge Co., Ltd., Birmingham.

Mr. W. L. Soul, Associate Member, has been appointed Assistant Chief Draughtsman of the Hoffman Manufacturing Co., Ltd., Chelmsford.

Mr. L. R. Targett, Associate Member, has been appointed Works Manager with Parnall, Ltd., Bristol.

Mr. Norman Ward, B.Sc.(Eng.)(Hons.), Associate Member, recently Senior Lecturer in Mechanical Engineering at Aston Technical College, Birmingham, is now Head of the Mechanical and Production Engineering Department of Handsworth Technical College, Birmingham.

Mr. G. S. Webley, Associate Member, has relinquished the position of Service Manager, Alvis, Ltd., Coventry, and is now Production Manager of that firm.

Mr. S. Wright, Member, has been appointed Works Director of Turner Manufacturing Co., Ltd., Wolverhampton.

Mr. D. E. Banham, Graduate, has been appointed Works Superintendent with Churchill-Redman, Ltd. (Scotswood Division), Newcastle-upon-Tyne.

Mr. C. Bartholomew, Graduate, has been appointed Assistant Lecturer in Engineering (Grade B) at the Leicester College of Technology and Commerce.

Mr. H. L. Faull, Graduate, of Holman Bros., Ltd., has been appointed their Resident Engineer, South East Asia.

Mr. F. Hooson, Graduate, is now a Lecturer in Mechanical and Production Engineering subjects at the Lincoln Technical College.

Mr. A. N. Muderji, Graduate, has taken up an appointment as an Assistant Works Manager at the Machine Tool Prototype Factory, Government of India, Ambarnath.

Mr. C. Phillips, Graduate, has been promoted to Engineer II, Ministry of Supply, at the R.O.F., Glasgow.

Mr. P. H. Roberson, Graduate, has taken the post of Planning Engineer with Perry & Porter, Ltd., Lincoln.

Mr. S. R. Tyler, Graduate, has taken up the position of Senior Design Engineer with Joseph Lucas (Gas Turbine Equipment), Ltd.

Mr. J. Walker, Graduate, is now employed as a Tool Designer with " Canadair ", Ltd., Montreal.

Mr. V. J. L. Whitley, Graduate, has taken up the post of Assistant Manager of Machine Shops with the Hart Foundry Company, Birmingham.

1951 SUMMER SCHOOL

A very limited number of copies of the proceedings of the 1951 Production Engineering Summer School, which was held at University College, Durham, from 29th August to 2nd September, 1951, is now available.

These Proceedings are priced at 2s. 6d. a copy, and may be obtained from the Head Office. In view of the limited supply early application is advised.

HAZLETON MEMORIAL LIBRARY

It would be helpful if, in addition to the title, the author's name and the classification number could be quoted when borrowing books.

ABSTRACTS

331.1 PERSONNEL MANAGEMENT : EMPLOYER-EMPLOYEE RELATIONS

" The Changing Culture of a Factory " by Elliott Jacques. *Tavistock Publications, Ltd., London.* 1951. 341 *pages.*

An account of an unusual piece of research, carried out over a period of three years in a London engineering factory, by the Tavistock Institute of Human Relations. Aimed at studying first hand the psychological and social forces affecting the life of a single industrial community, this report, by recording actions and feelings of managers and men, lays bare the emotional stresses in a factory striving for progress.

A revealing picture of executive planning and consultative functions, and how the final pattern was partially resolved by the research team " working through " actual social tensions, and thence recommending and facilitating agreed social changes. It stimulates self-analysis on the vital subject of the future role of Joint Consultation.

002 DOCUMENTATION

" Punched Cards, Their Applications to Science and Industry " by Robert S. Casey and James W. Perry. *Reinhold, New York.* 1951. 506 *pages. Illustrated. Diagrams.* £4

The first part of the book describes forms of coding for various purposes, and also systems of punched cards commercially available in America. Hand sorting is discussed in detail.

The second section describes 14 specific applications of punched cards, including cards for personnel records, wage computations, and materials accounting. Two applications describe systems for production control, and a further section describes an application suitable for use in technical libraries. The third section deals with fundamental problems in connection with punched card systems.

There is a large bibliography. It should be noted that the book gives information on simple "manual" systems involving hand punching and sorting, as well as highly complex fully mechanical systems.

657 ACCOUNTANCY

"Budgetary Control" by H. P. Court. *Sweet & Maxwell, London.* 1951. 282 *pages.*

Stress is laid on the co-ordination of methods and practice, and an endeavour is made to dispel the thought that the introduction of Budgetary Control is necessarily accompanied by a spate of paper work.

Methods are described which may be adopted for general use, and attention is drawn to obtaining the maximum use from the minimum number of printed forms, thus restricting the number of clerks involved and speeding up the preparation of control statements.

OTHER ADDITIONS

620.19 DEFECTS AND DETERIORATION IN MATERIALS : CORROSION

Uhlig, Herbert H., *ed.* **"Corrosion Handbook."** Ed. by H. H. Uhlig —and sponsored by Electrochemical Society Inc. *N.Y., Wiley ; Lond. Chapman & Hall.* 1948. 1,188 *pages. Illustrated. Diagrams.*

621.365 ELECTRIC FURNACES

Paschkis, V. **"Industrial Electric Furnaces and Appliances."** *N.Y., Interscience Publishers Inc.* 1945–48. 2 *volumes.* 232 *pages.* 320 *pages. Illustrated. Diagrams.*

621.777 SHEET METAL WORK

Dickason, A. **"Geometry of Sheet Metal Work."** *Lond., Pitman.* 1950. 325 *pages. Diagrams.*

621.791 WELDING

Philips Electrical Limited, *London.* **"Practical Welding Course."** (2nd Ed.) *Lond., the firm.* [19—]. 225 *pages. Illustrated. Diagrams.*

621.822 BEARINGS

Palmgren, Arvid. **"Ball and Roller Bearing Engineering."** (2nd Ed.) Tr. by G. Palmgren and B. Ruley. [*Philadelphia, Skefko Ball Bearing Co. Ltd.* 1946.] 270 *pages. Illustrated. Diagrams.*

621.83 GEARS

National Broach and Machine Company, *Detroit.* **"Modern Methods of Gear Manufacture."** (3rd Ed.) *Detroit, The Company.* 1950. 172 *pages. Illustrated. Diagrams.*

621.888 SPRINGS

American Steel & Wire Company, *Cleveland.* **"Manual of Spring Engineering."** *Cleveland, The Company.* 1941. 132 *pages. Illustrated. Diagrams. Charts.*

621.89 LUBRICATION

Michell, A. G. M. **"Lubrication, Its Principles and Practice."** *Lond., Blackie.* 1950. 317 *pages. Illustrated. Diagrams.*

621.9 MACHINE TOOLS : MACHINING

Plumridge, Tom C., *and others.* **"Machine Tool Guide."** Engineering data covering the principal machine tools—by T. C. Plumridge, R. W. Boyd and J. McKinney. *Chic., Am. Tech. Soc. ; Lond., Tech. Press.* 1945. 702 *pages. Illustrated. Diagrams.*

Walker, William F. **"Form tools : a guide to their design, manufacture and use."** by W. F. Walker ; ed. by E. N. Simons. *Lond., Hutchinson's Scientific and Technical Publications.* 1947. 301 *pages. Diagrams.*

B.S.A. Tools Ltd., *Birmingham.* **"Laying-out Tools and Designing Cams for B.S.A. Single-Spindle Automatic Screw Machines."** *Birmingham, The Firm.* [n.d.]. 109 *pages. Diagrams.*

621.97 PRESSES : PRESS-WORK

Pearson, Claude E. **"Extrusion of Metals."** *N.Y., Wiley ; Lond., Chapman & Hall.* 1944. 205 *pages. Illustrated. Diagrams.*

629.13 AIRCRAFT ENGINEERING

Devons, Ely. **"Planning in Practice : Essays in Aircraft Planning in Wartime."** *Cambridge, Univ. Press.* 1950. 231 *pages.*

657 ACCOUNTANCY

Henrici, Stanley B. **"Standard Costs for Manufacturing."** *N.Y., McGraw-Hill.* 1947. 289 *pages.* (McGraw-Hill accounting series.)

658 INDUSTRIAL ORGANISATION : MANAGEMENT

Spade, Mark. **"How to Run a Bassoon Factory ; or, Business, Explained ; and Business for Pleasure."** *Lond., Hamilton.* 1951. 262 *pagrs. Illustrated.*

658.54 TIME AND MOTION STUDY

Speakman, A. J. **"Work Study and Incentives : An Introduction."** *Manchester, Emmott.* 1951. 90 *pages. Illustrated. Diagrams.* (Mechanical World Monographs.)

Schutt, William H. **"Time Study Engineering."** *N.Y., McGraw-Hill.* 1943. 426 *pages. Illustrated. Diagrams. Charts.*

658.562 INSPECTION : QUALITY CONTROL

Michelon, Leno C. **"Industrial Inspection Methods."** (Rev. Ed.) *N.Y., Harper & Brothers.* 1950. 566 *pages. Illustrated. Diagrams.*

669 METALS : METALLURGY

British Specialist Team on Scarce Materials. **"Saving Scarce Materials : Report of a Specialist Team which visited the U.S.A. in 1951."** *Lond., Anglo-Am. Council on Productivity.* 1951. 28 *pages.* (Productivity Report.)

Great Britain—*Dept. Scientific and Industrial Research—Technical Information and Documents Unit.* **"Bibliographical Survey of the Development and Use of Substitute Materials for Non-Ferrous Metals and Alloy Steels in Germany."** Report No. R.M.S. –2. *Lond., H.M.S.O.* 1951. 46 *pages.*

669.14 STEEL

Allegheny Ludlum Steel Corporation. **"Tool Steel Handbook."** *N.Y., U.S. Steel Export Co.* 1951. 197 *pages. Illustrated. Diagrams.*

Seabright, Lawrence H. **"Selection and Hardening of Tool Steels."** *N.Y., McGraw-Hill.* 1950. 263 *pages. Illustrated. Diagrams.*

REVIEW

"The Instrumentation of Open-Hearth Furnaces." The British Iron and Steel Research Association. *George Allen & Unwin, Ltd., London.* 173 *pages. Illustrated. Diagrams.* Price 30/–.

It is only in the past decade that a serious effort has been made to give a full picture of what is happening in the furnace. In this endeavour B.I.S.R.A. have taken a leading part, and it is fitting that the first book on the subject, with a foreword by Sir Charles Goodeve, should come from them.

A sample list of primary measurements has nine entries, with six secondary quantities, which it is desirable or necessary to measure, and this list is not

exhaustive. Each of these types of measurement is discussed and examples are given of suitable measuring instruments of various types with their principles of operation. The use of these readings and their application to automatic control are explained from the practical angle, and there are many clear illustrations and diagrams.

PAPERS RECEIVED

"Production Engineering and Industrial Development" by J. D. Scaife, Hon. M.I.Prod.E. M.I.Mech.E.,
(Presented to the British Engineering Association of the River Plate, in Buenos Aires, December, 1950).

1817. **"Machine Tool Industry"** by W. J. Morgan.
1820. **"Craftsmanship of Output as Applied to American Brass Foundry Work"** by F. E. Rattlidge, A.M.I.Prod.E.
1843. **"Drop Forging"** by K. Fidler.
1850. **"Preservation, Identification and Packaging"** by Frank Chapman.
1852. **"Manufacture of Rubber Covered Cable"** by C. Plews, Grad.I.Prod.E.
1855. **"Standardisation"** by R. E. Mills, A.M.I.Prod.E.
1861. **"The Systematic Application of Motion and Time Study to the Manufacture of Tapered Roller Bearings"** by E. H. Collins.
1864. **"The Training of Production Engineers in Universities and Technical Colleges"**—Open Forum.
1868. **"Hydraulics as Applied to Reciprocating Machine Tools"** by George Butler.
1869. **"Automatic Lights for Lighthouses, Lightships and Buoys"** by W. J. B. Coombe.

THE LIBRARY Members are asked to note that until further notice the Library will not be open on Wednesday evenings or Saturday mornings, but will be open between 10 a.m. and 5.30 p.m. from Monday to Friday each week.

JOURNAL BINDERS Members are reminded that binding cases for the Journal are obtainable from Head Office, price 7/6 each post free. The cases, each of which will hold 12 issues of the Journal, are made of stiff board covered with imitation leather cloth, with gilt lettering on the spine.

RESEARCH PUBLICATIONS A number of copies of the following Research publications are still available to members, at the prices stated :

Report on Surface Finish, by Dr. G. Schlesinger	15/6
Machine Tool Research & Development	10/6
Practical Drilling Tests	21/-
Test Charts for Machine Tools, Parts 3 and 4	5/6 each

These publications may be obtained from the Production Engineering Research Association, "Staveley Lodge", Melton Mowbray, Leics.

ISSUE OF JOURNAL Owing to the fact that output has to be adjusted to meet requirements, and in order to avoid carrying heavy stocks, it has been decided that the Journal will only be issued to new Members from the date they join the Institution.

IMPORTANT In order that the Journal may be despatched on time, it is essential that copy should reach the Head Office of the Institution not later than 40 days prior to the date of issue, which is the first of each month.

GRADUATE ACTIVITIES

WOLVERHAMPTON

At the first meeting in 1952, a large audience heard Professor T. U. Matthew lecture on " Education for Industrial Management ". A vote of thanks to Professor Matthew for his most interesting lecture was proposed by Mr. L. W. Farrar, of the Senior Section.

The Works Visit for the month was made on 9th January to the Darlaston works of Guest, Keen & Nettlefold, Ltd., where the members found much to interest them.

BIRMINGHAM

The Technical Paper Sub-Committee has inaugurated a scheme whereby junior members in the Section will be encouraged to write papers. Members have been asked to prepare an essay of approximately 750 words, which may be either a critical discussion of a lecture given to the Section, or a technical survey of a Works Visit.

Two prizes will be awarded by the Graduate Section Committee for the two best essays, which will be judged by the Technical Paper Sub-Committee. The first awards will be made for essays written during the period ending 30th June, 1952.

LONDON

The Technique of Tooling Study Group is at present investigating the relative merits of various jig and fixture elements, compared on a time basis. It is eventually intended to compile a set of data sheets for the use of inspectors, designers, students, etc.

The Group Secretary would be pleased to receive any information which would advance the Group's investigation of the times (comparative in % or actual) required to replace renewable, loose drill jig bushes retained by various means. Assistance would be particularly valuable at this stage of the work, and contributions should be sent to the Group Secretary, Mr. G. Wittenberg, 34, Barkston Gardens, Earl's Court, London, S.W.5, as soon as possible.

Students and Graduates are welcome to join this Study Group, which meets on Wednesdays, once in 3/4 weeks, at 36, Portman Square, W.1.

SHEFFIELD

The Section Committee of the recently-formed Graduate Section has delegated to certain members responsibility for maintaining interest in Institution activities in specific areas. Each of these members will be expected to encourage other members in his own particular area to attend meetings, to approach suitable individuals with a view to obtaining their membership of the Institution, to introduce and meet new members on their first attendance at a meeting, and to invite and bring visitors to meetings whenever possible

THE ORGANISATION OF PRODUCTION ADMINISTRATION FOR HIGHER PRODUCTIVITY

by B. E. STOKES, Grad.I.Prod.E.

In this paper Mr. Stokes, who was one of the two 1950 Schofield Scholars, gives an abridged version of his Scholarship paper, followed by a Report of his tour of America.

THE Schofield Travel Scholarship paper gave me an opportunity of expressing a number of thoughts and ideas with which I had become increasingly preoccupied since leaving the Army and returning to industry. In visiting factories, and in talking with factory executives, I was surprised to find that a number of almost identical problems were experienced in dissimilar industries operating under quite different conditions. These problems could broadly be described as " administrative." Typical examples were variation in departmental interpretation of company policy, the duplication of some essential activities while others were more or less left to chance, the continual failure of attempts to plan production, and insufficient understanding and will to make the production plan work. While considerable effort was being expended in improving processes and methods, little attention appeared to be paid to the administrative activity which was essential to and seriously influenced the results obtained from the processes and methods being used. It seemed to me that, since the administration of production was an essential part of production activity, it should be " organised " with the same care and attention actually being applied to the " engineering " of process and method. The existence of the common administrative problems could only indicate that the need for this " organisation " was not generally recognised.

In all cases the day-to-day operation of the Production Control activities of the different Companies very clearly reflected these various problems, and investigation showed that their effect and extent could most profitably be studied through the Production Control Departments. My original paper, therefore, after giving an outline of the functions of Production Control, dealt with a number of these common problems and suggested both lines along which possible solutions lay and possible forms of further research in the United States.

This paper first gives an abridged version of my original Schofield Scholarship paper, followed by a general review of the United States social and industrial activity. This review is used as a basis for further comments on the organisation of production administration in the United States.

THE ROLE OF PRODUCTION ADMINISTRATION

Production Administration is concerned with the direction and control of the execution of production policy at all levels. It is concerned with the manner in which production personnel and equipment are directed and used in achieving the immediate aim of the manufacturing unit, i.e. customer satisfaction with the best possible manufacturing efficiency.

Since the range of different situations is as wide as the number of individual manufacturing units, there clearly cannot be any universal system of Production Administration. Even so, in the majority of cases it must be concerned with the same basic principles and functions. In its co-ordination and interpretation of any Production or Manufacturing Policy, it must be primarily responsible for ensuring that the policy of each department involved in manufacturing activity is intent upon the common purpose—customer satisfaction with maximum efficiency. Co-ordination is therefore required in the activities of departments responsible for the Planning of Layout, Process and Manufacture; Quality; Tool, Material and Component Stores; Personnel; Wages Payment; Time Study, etc.

The major tool of Production Administration in ensuring the physical planning and co-ordination of these activities to achieve the common purpose is that of Production Control. Any failure in Production Administration will, therefore, be reflected in the operation of Production Control, which can only plan and co-ordinate widely different activities and processes when the policies concerning these activities are mutually conceived to achieve the same end. It is impossible to co-ordinate mutually exclusive policies, even though it is frequently attempted, and neglect of this truism gives rise to a number of administrative problems.

Unfortunately, it is not always obvious that policies are mutually exclusive. For example, I have found on several occasions that a company financial policy has set limits on the value of holdings of raw material, work in progress and finished component stock. At the same time, manufacturing policy has required the production of batches of components the size of which can only be supported by stocks and work in progress far in excess of those permitted by financial policy. The inevitable result is a series of apparently insoluble problems arising in the day-to-day operation of Production Control.

It is clear that Production Administration must play a vital part in raising productivity and that it must be organised to make its maximum contribution. Its deficiencies give rise to Production Control problems, and the existence of a number of such problems common to widely different industries would indicate that the need for such organisation is not widely recognised. Thus I intend first to indicate some general Production Control functions and then to treat a number of these problems in detail in order to suggest a number of fundamental principles of good administrative practice, to which more attention should be given.

FUNDAMENTALS OF PRODUCTION CONTROL

Economic production cannot be attained merely by manufacturing a product at the cheapest possible price, since if there is no demand for the product, the fact that a particular manufacturer can make it more cheaply than any other manufacturer would be no deterrent to bankruptcy. Production must satisfy a demand and such satisfaction requires not only the right price, but also the right type of a specific quality, in the correct quantity at the right time. These additional qualifications require the detailed organisation of all phases of production and make essential some form of Production Control activity.

The importance of Production Control has been emphasised by the rapid growth in size and complexity of modern industry. With the introduction of new and more costly equipment, with improved methods, and with the increased tempo of manufacture the earlier administrative arrangements, designed primarily to relieve difficulties as they occurred, have proved unsatisfactory and inadequate. These improvements in manufacturing technique can only increase overall efficiency to the fullest extent when operating under the best possible conditions; that is, when the administration of production is organised to prevent difficulties arising. Such an administrative arrangement demands adequate and systematic forethought and planning,, which is the job of Production Control.

Production Control is, therefore, the systematic use of initiative in

> " the Planning, Co-ordination and Control of all Manufacturing Processes in order to ensure efficient manufacture with customer satisfaction ".

The need for Production Control to be handled as a separate departmental activity will increase with the complexity of the organisation, that is, with the number of different sales orders, products, processes, materials, grades of labour, etc.

Within the simplest form of organisation, the one-man business, the planning and co-ordination will be handled principally within the head of the man and control will be a matter of self-discipline. With the growth of the business there is a limit to the amount of

detail one man can handle while still maintaining the direction of the business, and at some stage there is a delegation of authority requiring the issue of instructions. Increasing numbers of components handled require the introduction of some form of identification. Division of labour destroys personal interest in the complete manufacture of each job and makes necessary some form of progress record. Independent manufacture of mating components requires some permanent form of detail of manufacture and so on. Each factor tends to increase complexity and emphasises the importance of dovetailing each independent activity into an integral whole as vital for successful day-to-day operation.

In order that production control can carry out this vital activity it requires basic information of sales requirements, product specifications and manufacturing instructions in order first to produce a plan. This must indicate what must be made, in which department and by when in order to satisfy the customer. This step or function is generally referred to as:

Scheduling which translates the customer requirements into a form recognisable at each stage of manufacture. The more diverse the variety of production, the more detailed and accurate must be the schedule which must obviously be based on a clear understanding of those factors which influence component manufacturing time, in order that manufacture will be an orderly activity. The actual method of scheduling component parts will depend very largely upon the Company Policy governing the manufacture of such parts.

Schedules can only fulfil their function providing that they are capable of being achieved, and must be based on a knowledge of capacity. Such knowledge should be deliberately sought and is generally dealt with as part of the second function

Machine and Labour Requirement and Allocation, which compares capacity available with load placed and possible future load. Lack of capacity requires either the obtaining of additional facilities or sub-contracting or the ration of supplies to the customer.

Having ascertained that what must be done is a reasonable demand and indicated by when and where it must be done, detailed manufacturing instructions and authority to manufacture must be issued to the departments concerned. This is a job handled by

Manufacture Order Control, which will operate in a manner determined largely by the policy governing the manufacture of component parts, i.e. for " customer requirements " or " for stock ". Wherever possible the order or authority to manufacture should also be used as the authority for operator wage payment.

In those cases where production is " for stock " without direct relationship with customer requirements it is necessary to introduce

Stock Control, which keeps track of stock levels of raw material and components in order to prevent overstocking and consequent redundancy. It may also take over the scheduling of bulk supplies of raw material.

Finally, having planned and authorised production activity it is necessary to provide some arrangement whereby minor divergences due to unforeseen difficulties can be handled without upsetting the main objective of the plan. The function is carried out by

Progress Control, which is responsible for following the operation of the plan throughout all its stages, ensuring effective liaison between departments, remedying minor defects or contingencies and reporting major defects to higher authority.

Thus the fundamentals of planning and controlling have given rise to five interdependent functional activities which will vary somewhat according to production circumstances. It does not follow that these activities will be carried out by separate departments or sections, but they must be performed if production is to be efficient whether mass, continuous process, batch or jobbing production.

PRODUCTION CONTROL AND PRODUCTION ADMINISTRATION PROBLEMS

In considering the detailed operation of Production Control functions and the difficulties involved in such operation, it is clearly of the utmost importance that the manufacturing unit should operate in accordance with the set plan which co-ordinates the many phases of activity involved in turning out the finished product. Unfortunately, it is often the necessary independence and initiative accorded to the supervision of these various phases which makes it easy for a department to deviate from the plan without realising the cumulative effect, and widespread repercussions, which will follow. Deviation from the plan is Production Control's most serious problem, and consequently considerable attention should be given to those factors which contribute to this problem.

Deviation from the plan throws upon Progress Control the responsibility for any necessary replanning in order to keep the manufacturing unit operating, and in an organisation with wide division of labour and activity, breakdown of the plan tends to be cumulative and increasingly difficult to control as it spreads. Complete breakdown requires a complete hour to hour replanning of all activities by Progress Control under ever-rising pressure due to increasing customer dissatisfaction. All too frequently such replanning is accepted as a necessary part of business activity—all

too infrequently is it realised that such replanning is indicative of inefficient operation and the failure of the first four functions of Production Control, namely, Scheduling; Machine and Labour Requirement and Allocation; Manufacture Order Control, and Stock Control. Progress Control all too often plays the role of shock troops holding off disaster with every expedient at hand, when in fact it should be regarded as an insurance against unforeseen problems. Undoubtedly, no plan is likely to account for all contingencies and to this extent, therefore, Progress Control is necessary. Generally, however, such necessity will also vary inversely to the success achieved by the other four functions.

Deviation from plan is a common failure in many manufacturing units and some of its causes are equally common throughout a wide range of industries. On investigation these indicate varying degrees of failure to appreciate the principles of good Production Administrative practice. In order to illustrate these causes and their effects, I have chosen for examination three production control problems which are widespread and which I will refer to as

"The Priority Problem";
"The Economic Batch Problem";
"The Incentive Problem".

The titles may not be familiar but the substance will, I think, be clearly recognised.

THE PRIORITY PROBLEM

In compiling a component producing plan, the Scheduling and Machine Loading Sections must indicate at what period ahead of requirement each component must be put in hand in order to allow sufficient process time. This Date Planning, as it is called, requires a knowledge of:

(a) The operations or processes which must be carried out on each component and the machines on which the operations must be performed.
(b) The set-up time for each operation or process.
(c) The floor to floor time of each operation or process.
(d) The handling time to be allowed between each operation or process.

Thus, given the size of the batch and its requirement date, it is possible to calculate the machine and process load involved, the total process time and the starting date for each component. All that remains is to ensure that all like operations for every component are integrated to give steady machine loads and the correct component supplies at the right time. This activity has been likened to a game of chess and, no doubt because chess champions find much more lucrative employment outside industry, produces many headaches. In practice the procedure is simple enough providing the components and processes are few in number and

handled in, say, one general department, but when the number of factors increases to that point where one human being can no longer appreciate at one time the significance of all the factors on the state of balance, the arrangement breaks down.

The difficulty has been recognised and attempts to overcome it are based very naturally on an endeavour to make unnecessary the hour to hour planning. In a widely accepted method, the starting date is set at the process time plus a contingency allowance, ahead of requirement date and a pool of work is held at strategic points —usually before each group of similar operations. In theory this permits the hour to hour planning of each machine group by loading from the pool in a manner most satisfactory to machine utilisation.

In practice this arrangement gives rise to a number of serious problems. No firm production programme can be set for individual departments, and the daily activity is resolved by three forces, incoming work, choice of work in the pool, and progress pressure, all in relation to machine capacity. These tend toward a state of unbalance which can only be restored by some system of manufacturing priorities. This tends to throw major decisions back upon the Production Controller who can only make accurate decisions when he can see the whole situation in detail. But this is where we came in ! The arrangement arose because it was impracticable to see the whole situation in detail.

A further point of fundamental importance, but often overlooked, is that the priority system tends to bring about a most unsatisfactory change in responsibilities. Because no clear output requirement can be shown, the responsibility for achieving output cannot be put squarely on the shoulders of production supervision and tends to be placed on the Production Controller.

Clearly, if a plan is to be of any value it must indicate what must be done by when and cannot therefore succeed if subject to a number of independent, unco-ordinated departmental priorities. At the same time it must be sufficiently flexible to permit departmental arrangement of work within the plan without an overriding system of priorities. With increased flow production this problem would tend to disappear, but for the moment it requires much further study and I have some suggestions which provide the bases for further research.

Every organisation must know what it has to produce and by what date. It usually designates this production by a unit of time —generally a week, i.e. so many per week. Why not, therefore, base the planning on this unit of time ? Examine and divide each component into convenient production stages which can be machine loaded by one man (generally a department or group of similar machines). Break down the ultimate weekly requirement of customer orders into component requirements, etc., then plan each

component requirement to pass through each stage of its manufacture during one week. For example, a product containing a number of components is required at a specific rate per week. The weekly requirement of the product would be broken down to show each component requirement. Each component manufacturing route would be examined and broken down into significant stages designated by, say, a number code. These stages now indicate the number of weeks ahead of requirement at which the manufacture of each component must commence. Each component must now be planned to pass through each stage during one week, and plans for each stage issued accordingly. Quite clearly, under this arrangement, no department can be called upon to do more than one unit's worth of work within any one unit of time, i.e. no more than one week's work within one week. The system of priorities becomes quite unnecessary because, providing the unit of work is completed within the unit of time, the work may be loaded in whatever way is most satisfactory to the department or departments concerned. Production supervision responsibilities are clear, since the amount of work to be done at each stage is definitely stated well in advance and material and tool arrangements can be made accordingly. Manufacture must generally operate habitually to a scheme which is largely self-progressing, since any departmental failure is obvious. The scheme does not overcome associated difficulties due to, say, excessive machine breakdown, which must be tackled by direct action, but it does emphasise in a reasonable manner the manufacture of the right components at the right time in the right quantity and helps reveal the associated difficulties in their true light.

These suggestions are not theoretical. They have been applied with some success.

This examination of the Priority Problem has emphasised a fundamental principle with which Production Administration is vitally concerned.

> " The correct interpretation and allocation of responsibility is vital to the accomplishment of the immediate aim of the manufacturing unit—customer satisfaction with the best possible manufacturing efficiency ".

The second of the three Production Control problems which I intend to discuss is:

THE PROBLEM OF THE ECONOMIC BATCH

It is frequently stated that machine set-up time must always be justified by the running time. Production Shops tend to scrutinise manufacturing orders in the light of this and reject so-called short orders

because they are not " economic ", explaining, of course, that if the orders could be increased to such and such a figure, considerable " saving " would result.

Though this approach is often modified by taking note of the cost of storing the excess items produced, it is clear that it reveals an attitude of mind open to serious criticism. The machine, perhaps an arbitrarily chosen machine, is determining manufacture quantity and not the true requirements; consequently the company concerned may have to wait many weeks for a return on manufacturing costs with serious reduction in turnover and increase in idle capital.

While it must be agreed that good machine economics are a laudable objective, it cannot be overlooked that this narrow conception of what is economic may not be so economic when considered as part of the whole. It is this which constitutes the most serious deficiency of this approach, the effect of which can be observed in activities such as the planning of process layout which calls for complicated and expensive tooling for components which, viewed from the overall company standpoint, could not possibly warrant such expenditure.

In addition there are serious control problems associated with this approach which require much more study. In changing conditions batch size information is difficult to maintain, modifications and customer change result in redundancy, while orders are raised on a stock level basis and tend to produce an out of balance machine load which is difficult to control without resort to measures somewhat contrary to the original objective of more " economic " runs.

The major fault of this approach lies in its lack of concern for overall company economics. The answer to the problem requires decisions on a number of factors:—

(a) The most profitable balance between machine requirements and the company requirements of turnover and its influence on Raw Material Stock, Work in Process and Finished Product Stock.

(b) The relative financial values of batch produced items and those which are flow produced and require little stock.

(c) Company or Customer Policies which may demand frequent changes;

and the final factor which embraces all these

(d) The successful control of complex activities.

From these basic points, Production Administration must clearly interpret manufacturing policy. It must be then understood by everyone concerned that, when an item is ordered in line with this policy, it is to be manufactured.

Only on this basis is it possible to plan successfully. The desire for long runs is admirable and should be fostered—so long as there are requirements to substantiate it.

This has emphasised a further Production Administration fundamental—

> " Individual policies and procedures control activities which are only a means to an end. The success or failure of each activity must be measured by the contribution it makes to the whole ".

The third typical problem is:—

THE INCENTIVE PROBLEM

An ill-considered incentive scheme will indirectly, but quite definitely, prevent the attainment of the production plan. This does not appear to be widely recognised and consequent problems arise most frequently with indirect operator incentive schemes for supervision, tool setters and the like because such schemes often ignore a fundamental requirement of an incentive—that in addition to offering a reward for additional effort, it should also ensure that such effort is directed towards making what the company wants.

These problems do not normally arise with direct operator incentives which bring their own peculiar troubles arising from, among many things, a general endeavour to do those jobs which give the best reward for the least effort. However, if supervisory bonus is related only to numerical output without reference to the completion of the programme within a given time, as is often the case, supervisory effort may in fact tend to encourage the direct operator endeavour with a consequent increase in the apparent difficulties in attaining the overall programme. Such difficulties can only be overcome by introducing a supervisory incentive scheme based in part upon the completion of programme by the due date which, in turn, emphasises the need for solution to both the Priority and Economic Batch Problems, and provokes the thought that faulty incentive schemes are a reflection of the inadequacies which gave rise to these problems.

Other indirect operator incentive schemes also raise similar difficulties and particularly those for change-over tool setters, which are often based primarily on machine utilisation on the assumption that the department must be most effective when the machine utilisation is at a maximum. Since maximum machine utilisation will occur when changeovers are at a minimum, the setter becomes progressively better off as he does less work. The situation is again aggravated if Supervision bonus is based on numerical output as distinct from completion of programme.

The Incentive Problem is clearly very much concerned with the Economic Batch Theory. It arises from a completely erroneous

idea of machine utilisation in which the machine requirements dominate the company requirements. If the company requires twenty jobs during a given period in order to achieve customer satisfaction, the changeovers required for these jobs must be done in order to obtain the best overall utilisation—the incentive scheme ought to ensure that changeovers are effected as quickly and efficiently as possible without regard to the number required.

The examination of this problem has emphasised Production Administration's most fundamental requirement:

> "*All policies bearing upon production activities must be intent upon the common purpose*".

The definition of common purpose is all important. On it will depend the true activities of many independent functions. If the activities are not co-ordinated, productivity will be endangered, not enhanced. The true aim, customer satisfaction with maximum efficiency, is synonymous with the highest possible productivity. This does not, of course, preclude attempts to mould customer requirements in order that customer "satisfaction" can be achieved by less complex manufacturing arrangements.

CONCLUSIONS ARISING FROM EXAMINATION OF TYPICAL PROBLEMS

The examination of these aspects of Production Control activity and problems has indicated deficiencies in widely accepted Production Administration practice, deficiencies which have a common cause—the lack of true perspective within the direction of the manufacturing unit. This is due, I think, to concentration and consequent specialisation on the improvement of manufacturing methods without equal consideration of the activities which make such improvement possible. The organisation of Production Administration must be concerned with restoring and maintaining perspective. I considered that American experience could possibly help us in this task and my Travel Scholarship was devoted to an investigation of American Production Administration activities.

THE AMERICAN APPROACH

This brief outline of my original Scholarship paper has, I hope given you some general ideas of the problems and principles about which I was anxious to learn something more from an examination of industrial practice within a number of American Companies. This opportunity also presented an equally absorbing prospect in the possibility of discovering just what sort of human confusion lay behind those neat bundles of statistics which America delights to export to those countries who desire to know how many American beans make five! After all, engineering activity has been created through the process of satisfying human needs; it seems reasonable, therefore, to assume that the principles evolved for the operation of

an engineering establishment should reflect the form of the need through which it was created, and which is in turn a reflection of the social background of the people.

This latter point has been made in a rather different way by several of the more recent Productivity Team Reports which, in considering the reasons for high productivity in the United States, have frequently referred to the importance of the American Approach. It has been reported that this approach has led to the more extensive standardisation of product and process within the American factory, greater product specialisation within manufacturing units of all sizes, an ever-widening use of mechanisation and consequent multiplication of worker effort, a less conservative attitude towards change and greater desire to try out those things which are new, the comparative absence of restrictive practices and many other factors which materially contribute to high productivity. My own experience seems generally to confirm these comments, and many times during my visit I found myself asking what there was in the background to and substance of everyday life in the U.S.A. which gave rise to this different approach so potent in raising the material standard of living? Was this approach something that the Americans had adopted as a result of a conscious and searching appraisal of what they individually wanted out of life, or was it more a product of the circumstances in which their civilisation had grown? What was the actual impact of this approach with its consequent high standard of living on life in general? Was life made more full or more restrictive? And a host of similar questions.

The correct answers to these questions are difficult to discover but I feel that I should make some comments on the points which struck me as important, since they must inevitably reflect upon both the form of American Production Administration Organisation and the manner in which I viewed it. The following comments on the American background and its influence on life at home and at work attempt to present part of my experience of the American Approach.

THE SHAPING OF THE AMERICAN NATION

Though basic manufacturing techniques were taken to the United States from Europe, the development of these techniques took place in circumstances essentially different from those in Europe. Initially, the American Industrial Revolution developed from a background agrarian and pioneering in character, and a society practising democratic ideals deliberately chosen in order to exclude the feudal practices of the societies from which the earlier settlers had originally come. The people, largely free from class distinction except in the Southern States, believed in the conquest of natural difficulties,

made a duty of self-advancement, and encouraged those with ability to assert themselves without regard to social background. Lincoln expressed these general ideals in a message to Congress in 1861, in which he described America as a country with a "just and generous and prosperous system which opens the way to all —gives hope to all and consequent energy and progress and improvement of condition to all", where the large majority of people were neither employers nor employees, but were working for themselves asking nothing of capital or hired labour, where the hired labour could save the surplus from his wage in order to buy tools or land to work on his own account until he, too, could hire a beginner to help him.

The nature of these ideals gave a remarkable impetus to the development of industrial capitalism in the United States, since industry opened new fields for pioneering and presented a continuously expanding challenge to a nation who believed that achievement was largely a matter of personal courage and initiative. In addition, apparently limitless raw materials were available for exploitation.

The pattern of the ensuing industrial growth was further shaped by the influence of mass immigration, principally by Europeans tempted by the promise of freedom and equality and the possibility of getting rich quick! Between 1840 and 1900, over 16 million immigrants entered the United States and between 1901 and 1930, almost 20 million. Such a movement of peoples has no parallel in history. The rapid assimilation of these immigrants into the community was probably responsible for several significant factors which contribute to America's higher productivity.

For the most part these immigrants were anxious to become identified as members of the new community as quickly as possible. The process of assimilation was achieved both by imitation and by the influence of the American Educational System, which first developed from the need to weld together a heterogeneous collection of peoples into a national unity. This desire to be 100 per cent. American, which is very significant in American life and affairs to-day, has given rise to what are almost national forms of self-expression, social habit, dress, personal possessions and a concern to be "like the other man". Mass production of a standardised article by Henry Ford and his contemporaries was not forcing upon the mass of people something which they did not want, but was a recognition and brilliant exploitation of a unique social need.

THE SHAPING OF AMERICAN INDUSTRY

Against this background the early years of the Twentieth Century saw the expansion of the consumer goods industries during the peak of the flow of immigrants, the majority of whom were now turning to

industry for employment. This labour force was for the most part insufficient and unskilled and required the simplification of skilled jobs by breakdown into elements which could be assimilated quickly. Such a process, which was being bitterly resisted in Europe, was welcomed in the United States because it opened up job opportunities and permitted the required mobility of people to continue.

The shaping of the pattern of industrial activity was further influenced by the widespread belief that all progress was the result of competitive struggle between individuals, a belief in keeping with the business philosophy of the age, and not incompatible with the duties of self-advancement and self-assertion expressed in the early American ideals in the shaping of which, incidentally, imported religions had played a part. For all men, in the Northern States at least, there was equality and the promise of success providing they had drive and initiative. The prize for which the new pioneers laboured was not land but money, the possession of which was used as a measure of success and personal achievement. Perhaps of equal importance was the prospect of " getting rich quick ", which was tangibly demonstrated during the gold rush. Such a system of measurement in turn provided a force highly effective in promoting continued industrial expansion. Though the force was frequently ruthless in operation, particularly with the growth of the large corporation, such ruthlessness was apparently very largely accepted by the majority of people as the natural state of affairs, as were the economic crises which racked the country from time to time.

Business had become a force in American life. In the main its growth and development had been uninhibited by controls or restrictive practices other than those which it had itself imposed and continued in sheltered conditions. Its expansion by the acquisitive desires of the society which created it was in turn assisted both by the unique nature of this society and the acceptance of measurement of achievement based upon material values. In addition government activity was, for the most part, favourable. Furthermore, though business activity was slowly making impracticable those ideals from which the mainspring of its activity had come, society generally continued to accept the ideals as a basis for thinking while basing actions on very different considerations.

SOME COMMENTS ON AMERICAN SOCIETY

The brief analysis of the background of the American people is not intended to do anything more than indicate the complexity of the problem which lies behind the question: " Why is productivity higher in the United States than anywhere else in the world ? " It gives you some idea why I have no simple answer, and makes somewhat more sensible

the comments which are to follow. Time prevents references to the influence of the form of government and political institutions, religion, Nineteenth Century economic theory and many other activities and problems which are also important in any consideration of the American scene to-day.

Present day standards by which Americans judge themselves are very different from the ideals of Abraham Lincoln. Far from being classless, as is frequently suggested—sometimes by Americans—American Society in becoming acquisitive has split into classes which are principally but not invariably defined by income group. Social standing is much a matter of possessing tangible evidence of having money, even if the money may in reality belong to the local finance company. I would tentatively suggest that wifely activities in spurring on husbands into earning more money, about which we have heard a great deal, is more a result of the desire to keep up with the Joneses in the possession of a new, two-barrelled, semi-sprung, elbow-action, chromium plated, 5 h.p. potato peeler than any altruistic desire to raise productivity. A more startling expression of this form of social distinction comes from 'teen-age girls who frequently measure their importance in the eye of the male by the amount of money spent on them during a " date ".

The importance of financial success is boosted in innumerable ways through widespread advertising, and it is an accepted though not always conscious requisite of personal achievement that it can be measured financially. The underlying principle expresses itself in many colloqualisms—when an American feels good he " feels like a million dollars ". Perhaps it is for these reasons that cultural activities tend to find principal expression in the higher income groups, while the average American follows practical pursuits in line with his tradition and the general trend of activities. Again, such an arrangement is at variance with the " ideal " which leads many Americans to the pleasant " belief " that the United States is the only place in which there is left any degree of personal freedom and individualism. This appeared to me to be very far from the truth; in many ways we enjoy considerably more freedom and individualism in Britain than is the case in the States, where there is a surprising degree of regimentation of thought and expression, largely self-inflicted, in the form of juke boxes, drug stores, radio, fashion, and the other paraphernalia of modern life in the United States.

However, whatever criticisms are made of this basis of social distinction, it has provided a force highly successful in the general prosecution of efficient business and a measuring stick of material success universally understood.

AMERICANS AT WORK

Seen against the background of these various factors it is not surprising that the six months which I spent working in a number of factories, while revealing very little evidence of higher worker effort than is common in England, indicated that the effort was far more effective. Though this latter point has become somewhat hackneyed by constant repetition, it is the significant common factor which is apparent in most American industrial activity. Considerable management time and energy has been devoted to the multiplication of human effort and the removal of its inherent uncertainty by the skilful use of all forms of tools. Both in workshop and office there is a sense of fitness for purpose which expresses itself in the provision of the most economical and suitable machinery, special if need be, but using standard units wherever possible, serviced if necessary with effective work holding devices whether it be a drilling jig or an indicating stand for typist copy, and adequately maintained, and employing a good layout to improve work flow and reduce handling. Where handling is necessary, power driven equipment essentially suited to the job is provided. In short, there is an active drive to increase the efficiency of most activities. Achievement is not unexpectedly generally measured by cost reduction; consequently cost statistics are distributed in various forms to all levels of management, and cost reduction achievement is sought by supervision as the fundamental basis of promotion. Budgets are widely used and for many different activities. Research, for instance, is budgeted on the basis of the amount of money the company is prepared to spend for the development of a product, and the Research Department ability judged on the results it obtains within the limit of the budget.

Inevitably, training for all levels of management reflects this attitude and as a consequence is more concerned that the pupil should have a broad knowledge of the whole process of manufacture, and for that matter of industry, than is the general case in Britain. This knowledge, however, is noticeably technical, not social. This broad knowledge improves the standard of demand made by management, particularly from the services offered by vendors of equipment and suchlike. As would be expected, principles observed in promotion tend to follow the traditional approach—whoever can make the grade can have the job—though this did not strike me as an invariable principle.

It is interesting to note that the widespread and continual changes which follow cost reduction activity have met with wide acceptance, both by employees who inevitably suffer some short term rearrangement or loss of job, and the general community, despite the fact that American Industry has lagged far behind Europe in the provision of measures to ameliorate any hardship which may arise. It is difficult to decide whether this acceptance is passive or positive.

Certainly since the war, change inherent in increasing productivity has been freely accepted so long as workers staying on the job received a substantial financial increase. However, worker security is receiving much more attention and there is no doubt that the recollections of the ruthless cost reduction activities which took place during the earlier growth of American Industry has spurred American Trade Unions to press for protection of the older worker. In many Company/Union Contracts, the regulations for ensuring seniority rights during lay-off periods are quite elaborate and indicate a growing concern with job security and a reduction in the traditional flexibility of operation. Another possible change in the tradition of mobility of labour, while not yet important, is indicated by the growth of small areas of chronic unemployment —20 to 30 per cent. of the population—which lie within 100 to 200 miles of areas of greater job opportunity but which nevertheless retain their high percentage of unemployment.

Worker participation in activities such as the J.P. and C.C. were not common; in fact I was surprised at the very small amount of worker/management co-operation with which I met in the States, since from all accounts in this country it had appeared to be a very strong factor. Local Trades Union opinion appears to be very much in favour of leaving management's job to management and being extremely critical of the final result. Demands for holidays, welfare facilities, safety precautions, bonuses, seniority rights and the like are, of course, positive and a number of union officials with whom I talked considered that these demands constituted a permanent goad to management to increase productivity.

Many comments have indicated that direct incentives are not popular in the United States, and that considerable savings in indirect personnel and the like result from the use of measured day work. Certainly this latter, combined with a lack of the somewhat topsy turvy additions to base rate which we suffer in Britain, does simplify wage payment activities. However, many management representatives with whom I spoke were very much in favour of a wider application of direct incentives and explained that this could not be achieved because of Trade Union opposition.

As an aside on Trade Union organisation and its reflection of the social conditions in which it was reared, it was not at all unusual to find that Local Union activities had been organised into life by representatives from the Central Office, rather than through a process of local growth in which workers with common aims banded together in order to further the aims and then joined with similar groups to form a Central Office.

INFLUENCE OF WORK HABITS ON HOME LIFE

As one would expect, the drive for cost reduction and labour saving with consequent increase in the use of machinery has influenced social life as it has factory life. The provision of slot machine canteens which dispense coffee with or without sugar and/or milk, biscuits, cigarettes, nuts, bottles of milk, chewing gum and the inevitable " coke ", suitably refrigerated, provides the most strikingly obvious difference between the American factory and its British counterpart. In the distribution of many consumer goods there are equally obvious differences, of which the huge self-service Super Markets and retailers' co-operative buying organisations are but two, and which are typical results of the effort to cut out the middle man. In many homes a battery of mechanised devices are on permanent call, heating, cleaning, beating, mixing and what-have-you. I refuse to refer to them all as labour-saving devices because a number take far longer to do a job than the old-fashioned method. It is probably in the mechanisation of ordinary life that the Americans are least imaginative; they have, as it were, taken the chew out of the chewing gum ! Many human pleasures have been canned out of existence, folks look upon walking as being antediluvian, and paraphernalia for such activities as fishing requires a 30 cwt. station wagon for transportation.

But these comments and ideas could continue *ad infinitum !* I must hope that this short survey has done something to indicate the background and form of the American Approach and its vital differences of tradition from those which we feel. Before moving on to indicate the possible influence of this tradition on principles of industrial operation and consequent forms of production adminstration, I must, however, mention a tradition at which both countries are at one, that of offering hospitality to a visitor, in which the many people whom I met were memorably generous.

THE NATURE OF THE AMERICAN ADMINISTRATIVE PROBLEM

Within my original Scholarship paper I indicated that Production Administration Problems increased with the complexity of the organisation. The administrative problem probably increases as the rate of the cube of the complexity. For instance, in a press shop containing 40 machines each engaged on the continuous manufacture of one component week in and week out, administrative problems are relatively simple and are concerned only with the provision of raw material, machine and tool maintenance and the despatch of the finished component. Raw material stock can be held at a minimum commensurate with delivery arrangements and rate of usage. Work in Process need be no more than that required to support the various stages of manufacture and if the manufacture is for assembly, finished component stocks

will be balanced and at a minimum commensurate with assembly requirements. In short, there will be a maximum return on capital invested with the minimum amount of trouble. Supervisory and various functional specialist energies can be concentrated almost entirely on the improvement of process or method, shop layout, handling facilities and the like and the actual rate of increase of productivity will be high.

If the same shop is required to produce 500 different components, each in turn requiring a number of operations to be carried out by different types of presses and utilising a wide variety of materials, the administrative problem is very different and infinitely more complex. The realities of financial policy which determine the amount and turnover of capital investment in various stocks and work in process present a number of problems requiring, to say the least, a nice sense of balance. Extracting from the shop the variety of components in the limited time dictated by financial policy, while maintaining reasonable plant utilisation and balancing work on press groups, arranging material supplies and keeping the operators happy by juggling the flow of work to mix the rough with the smooth, is by no means easy and very little is required to upset the overall balance of the shop. Considerable time and energy has to be devoted to shop planning; some check must be kept on quantities manufactured in order to prevent over-production of one component to the detriment of another which is manufactured from the same material. Since the combination of components in all probability presents no common flow pattern, machines have to be laid out in groups of like types and progress men ferret among the piles of work in process which is not in process in order to find out why. Maintaining identification of components at various stages suddenly becomes a nightmare because the two blokes who've been with the Company fifteen years have 'flu. Unbalanced stocks of finished components awaiting assembly present problems in the control of the introduction of modifications, and life is very difficult.

Supervisory and various functional specialist energies must now be spread over a wide range of activity and are as frequently concerned with keeping the customer quiet as with improvement of method, which in many cases may probably not be economic and the actual rate of increase of productivity will be low. There are also a number of external problems. For instance, with the increase of complexity, records become much more important and at the same time much more difficult to maintain accurately.

These two illustrations are more or less opposing extremes and quite obviously the people who enjoy the first have a much simpler problem than those who suffer the second. My general investigations of Production Administration Practice within the limited

number of American firms which I visited generally indicated that American companies tend to be far more like the first example than the second. The investigations which, to explain briefly, followed a pattern of product examination for variety of model and range of type, discussion of Company Manufacturing Policy and Administration Principles and survey of factory layout and a follow up of the points arising with the Production Control or equivalent department, generally showed a less complex problem in the American firm than would exist within its British counterpart. To put it more simply, the American companies have avoided many of the administrative problems arising from complex manufacturing activity by not becoming involved in many factors which create complexity—that is, the handling of wide diversity of product within the manufacturing unit with its consequent wide range of material requirement, large variety of component usage with attendant service problems, inability to take advantage of specialised and more efficient machinery and the flow layout of process which is largely self-progressing. Many companies are therefore able to concentrate their energies on a much narrower range of activity within research, product development, process improvement and suchlike. It is noticeable that even the smaller companies of 200 to 300 employees tend to specialise. Such companies may be devoted entirely to making bumper bars or hub caps, and even when specialising in such things as plastic moulding the demand has been so conditioned that quantities involved are sufficient to keep a machine permanently set up.

Seen against the background of the American Approach this does not appear at all unusual. Fundamentally American Industry has catered for a social demand simple in character and encouraging rather than rejecting standardisation. The size and unique features of this demand, cajoled, flattered and sustained by advertising and unencumbered by serious consumer selection, brought the economic advantages of large scale production to American consumer goods industries at a relatively early date, and with consequent reflection on all other industry. The labour force welcomed rather than opposed job simplification and the use of tools to increase wealth, and possessed little social cohesion as a class when exploited. Wealth as the basis of social distinction emphasised the importance of business, fostered competition and encouraged cost reduction as a measurement of progress.

At present there appears to be a general tendency throughout industry to increase diversification of product and complexity of manufacture, a trend which managements generally explained as necessary in order to attract more customers and/or increase resistance to economic fluctuations. To some extent this also indicates changing customer tastes. It is interesting to note that these trends

have been recognised by some educational institutions who have been giving attention to the problems of diversity for some years in order to determine relevant factors and to find some measure of their effect. It is reported that some difficulty has been experienced in obtaining industrial interest, and my own experience certainly indicated that in those industries where complexity was seriously increasing, surprisingly little attention had been given to the factors involved or to the provision of suitable machinery for handling those factors. Their immediate reaction, " increase the progress staff ", is not unknown in Britain !

The choice of retaining increased diversity within one plant with common manufacturing facilities in order to obtain a possible better use of those facilities but incurring complex problems of control, as distinct from the decentralisation of facilities to each product manufactured with possible inefficient use of plant but much simpler problems of control, appears to weigh heavily in favour of the second method, often without a full appraisal of the alternatives. Perhaps this choice is also one reflecting the traditional approach; Americans appear to dislike intangibles and these are inevitably mixed up with control problems. A not unreasonable dislike, I feel !

COMPARISONS BETWEEN AMERICAN AND BRITISH PRACTICE

There are some difficulties in making comparisons between American and British Industry, but, in general, my limited experience indicated that in those companies where complexity of manufacture was similar to that experienced by companies in Britain, problems such as I mentioned in my Scholarship paper were common and surprisingly similar. I enjoyed several long discussions on the *pros* and *cons* of the so-called " economic " batch which, in a number of companies, was proving a considerable nuisance due to the increase in the number of non-standard components which, when manufactured by the fastest process and in line with machine economics, gave rise to embarrassingly large stocks of material and work in process.

On the whole, general forward planning of activities seemed much more sound, probably because of the greater attention which has been paid to market research and the widespread attempt to budget production for considerable periods ahead. Relatively firmer and easier material supplies also assisted considerably in the maintenance of plans once decided. Detail planning, however, was not so good and companies manufacturing by batch production methods held buffers of raw material, work in process and finished stock which were high even by British standards and vastly dissimilar to the mass production industries.

Though direct incentive schemes are not so widespread in America as in Britain, work measurement is much more common,

not only as a measurement of direct operator activity, but also of many indirect jobs such as tool making and machine setting. I am sure that many of our incentive schemes for indirect workers could be improved considerably if they were based on work measurement, instead of some arbitrary hash-up often only remotely connected with the work done.

Comparisons on the size of staffs to carry out certain administrative functions, also a touchy point, show Britain in a relatively favourable position when the functions compared are actually similar. I found often that functions, though bearing titles similar to those in Britain and doing a similar job, were much less complex than was the case in Britain and it was the lack of complexity rather than personal effort which gave rise to difference in size os staffs.

Office mechanisation was principally confined to the use of electric typewriters, posting and calculating machines. Punched card equipment for such activities as material control and production planning did not appear to be widespread, though aggressive selling campaigns were in vogue. Those of my more personal critics will no doubt consider it inevitable that I should discover a company where the punch card set-up was being quietly spirited away and being replaced by hand posting.

THE STATUS OF PRODUCTION CONTROL

The position occupied by Production Administration activity and its major tool, Production Control, in those companies which I visited is difficult to summarise. Production Control was certainly considered a major staff function in all cases and in some the most important staff function to the manufacturing activity. As such, it operated under the direction of general management and not factory management, and frequently included all the related functions of material control, with storage, receiving, internal transport, despatching, etc., scheduling of all activities including new product co-ordination and machine loading control. Generally, the co-ordination of all these related functions under one head appeared to operate much more satisfactorily than the splitting of functions, with scheduling and control operating for factory management and other activities for general management. This was particularly noticeable in those companies with a complex manufacturing problem, and under this arrangement problems due to conflicting interpretation of policies were much less marked.

Attitude towards Production Control activity varied considerably. In one company the lack of appreciation of the purpose of the control and lack of desire to make it work had resulted in an elaborate set-up which was duplicated in a most unsatisfactory manner on the shop floor. This demonstrated all too clearly that lack of

understanding of administrative activity and lack of will to make it work will result in the failure of the activity even though there is nothing inherently wrong with it. This failure will inevitably reflect on the operation of the Company as a whole, and emphasises the importance of raising the general standard of " industrial " education. In commenting upon the latter I must mention the outstanding administrative training establishments in the United States from which we can learn a great deal.

In most companies attempts had been made to represent the organisation on some form of chart, with an indication of the duties and responsibilities within each function in order to prevent overlap. On this point American Companies were better finished off than is usually the case in Britain, and the organisation chart was more frequently kept up to date with the changes of organisation which must inevitably take place from time to time.

CONCLUSIONS

As my stay progressed in the United States, any simple explanation of the unique industrial activity became more and more impossible. Frankly, it seemed to me that the progress of American Industry is as much an unconscious expression of a continuous historical process as a conscious human endeavour to adopt such measures as would be necessary to ensure such progress. Americans have not, as a people, sat down and individually worked out the key to raising productivity any more than Britons sat down and decided to have an Industrial Revolution, and the American productivity-consciousness, about which a great deal has been said, is probably as much a part of this unconscious expression as of any conscious recognition that certain activities are necessary in order to increase productivity. This, however, is no excuse for complacency on our part. On the contrary, any adaptation of worthwhile American experiences to our own way of life must be entirely conscious and deliberate, since it may involve reversals of tradition.

Deciding just what American experiences are worthwhile and consideration of the manner in which they could be adapted presents us with what can only be described adequately as the British Dilemma. We must increase our productivity and we must raise the potential rate of increase both by reducing the complexity of our industry and by improving the standards of all levels of supervision, in order that problems of complexity can be more readily understood and handled. However, within any trend towards simplification of organisation and product we must retain our traditional advantage of producing " something different ", or of " better quality ", while becoming as cost conscious as our American cousins. We boast of our tradition to effect a good compromise; our present situation gives us perhaps the last chance to bring off the compromise of a lifetime.

It is not practicable within this short time to enumerate details of possible lines of improvement—these will be the subject of a separate paper—but I hope to have provoked some thought around the problems involved. In examining American experience we should remain aware that not all activities, which together make up the American Approach, are good or even worthwhile adopting. Many Americans themselves have grave personal doubts about many aspects of industrial activity within the States.

American Production Administration practice quite naturally reflects the trend of American industrial activity and while general principles are similar, the details of its experience cannot be easily applied to British industry. Its emphasis on the importance of good forward planning, however, is something we must apply as widely as possible since it assists all phases of production activity. In many ways our experience of complexity in industry could, in fact, be of value to those American industries in which complexity is increasing and it would be worthwhile for representatives of these companies to visit us.

Undoubtedly the basis of good administrative practice is the desire of human beings to work together. Lack of ability to work together appears to be as serious a failing in the United States as it is in Britain, and points to a lamentable paradox in modern industry in which we know all about machines but precious little about the people who design, operate and maintain them.

ACKNOWLEDGMENTS

There are many people and organisations to whom I owe grateful thanks for making the Schofield Travel Scholarship possible.

To Mr. E. W. Hancock, M.B.E., for conceiving and making practicable the Travel Scholarship idea, to the Scholarship Committee and Staff of the Institution for translating the idea into fact and to the Institution for the gift of such an outstanding opportunity.

To Messrs. Joseph Lucas Limited, for granting me leave of absence for the duration of the Scholarship.

To United States officials of E.C.A. for their help and to the many companies and organisations in the United States who made available their facilities with such generosity. My particular thanks are due to my " sponsor " companies:—

Kearney and Trecker Corporation, Milwaukee, Wisconsin;

Black and Decker Manufacturing Company, Towson, Maryland;

Ranco Incorporated, Columbus, Ohio;

and to the many Americans whom I met, for their warmhearted hospitality and kindness.

APPENDIX I

LIST OF PRINCIPAL COMPANIES AND ORGANISATIONS VISITED

Allis Chalmers Corporation	Milwaukee,	Wisconsin.
Battelle Memorial Institute	Columbus,	Ohio.
Bendix Company of Canada	Windsor,	Ontario.
Bendix Radio Corporation	Towson,	Maryland.
Black & Decker Manufacturing Company	Towson,	Maryland.
Ford Motor Company, River Rouge Plant	Detroit,	Michigan.
Gorton Manufacturing Company	Racine,	Wisconsin.
Harnischfeger Corporation	Milwaukee,	Wisconsin.
Heil Corporation	Milwaukee,	Wisconsin.
Houdaille Hershey, Oakes Division	North Chicago,	Illinois.
Kearney & Trecker Corporation	Milwaukee,	Wisconsin.
" Milwaukee Road " Maintenance Department	Milwaukee,	Wisconsin.
Motorists Mutual Insurance Company	Columbus,	Ohio.
Plymouth Plant	Detroit,	Michigan.
Ranco Incorporated	Columbus,	Ohio.
Illinois Institute of Technology	Chicago,	Illinois.
Ohio State University	Columbus,	Ohio.
Field Officers of U.S. Department of Commerce		
Local Chambers of Commerce		
American Economic Foundation	New York.	
American Standards Association	New York.	
National Association of Manufacturers	New York.	

APPENDIX II

REFERENCES TO GENERAL READING ON THE " AMERICAN APPROACH "

The American Experience.	Henry Bamford Parkes.	Alfred A. Knoff.
The American Economy.	Sumner H. Slichter.	Alfred A. Knoff.
An American Dilemma.	Dr. Gunnar Myrdal.	Harper & Bros.
American Economy in Operation.	Taylor & Barger.	Harcourt Brace & Co.
The American Union.	H. G. Nicholas.	Penguin.

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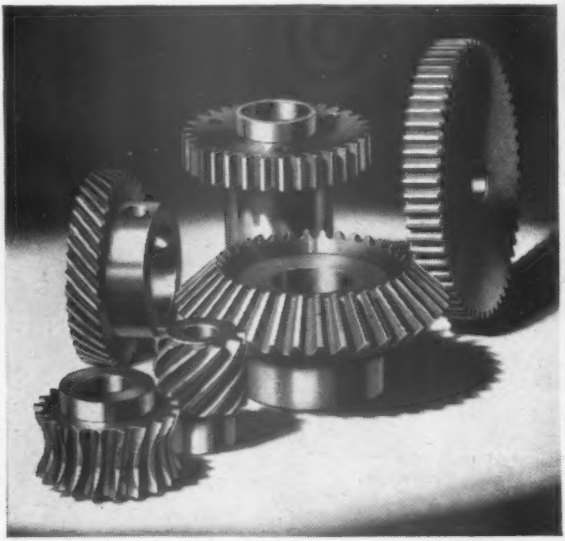

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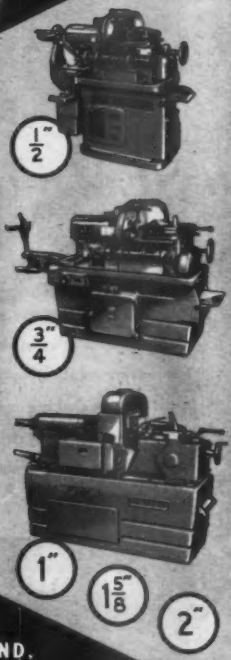

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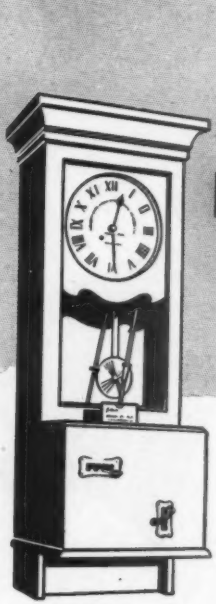

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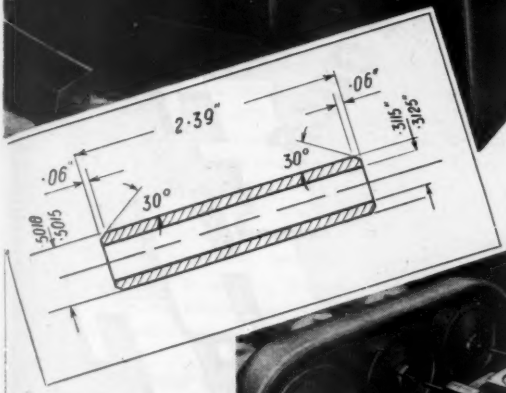

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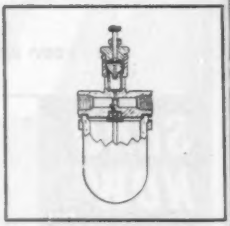

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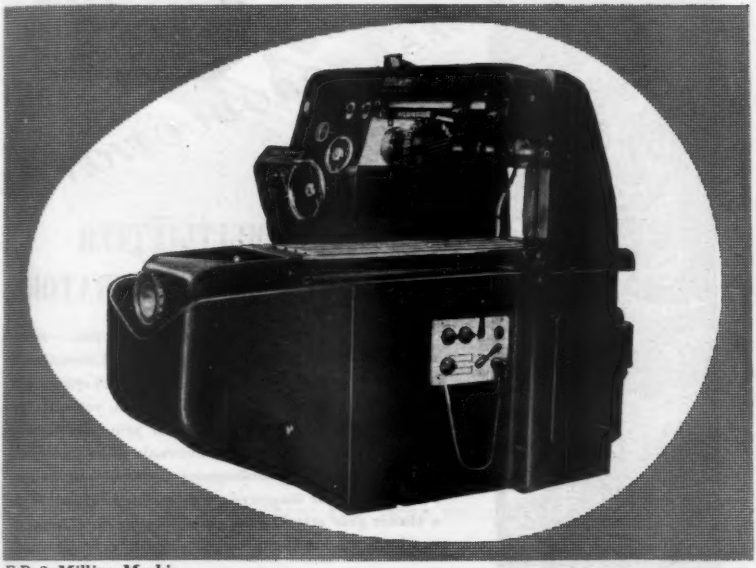

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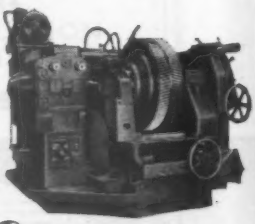

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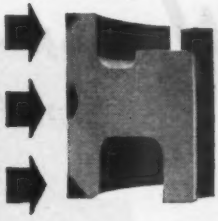

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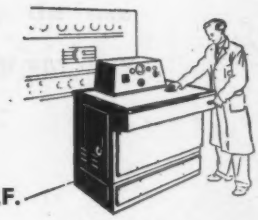

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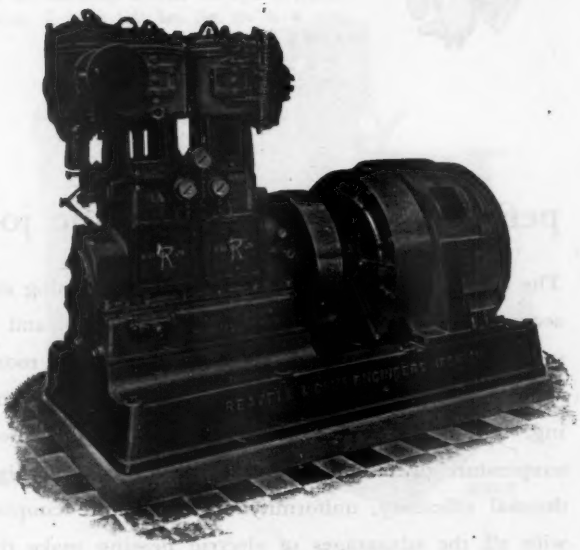

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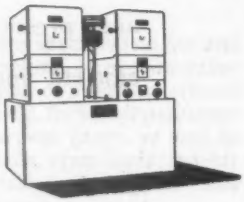

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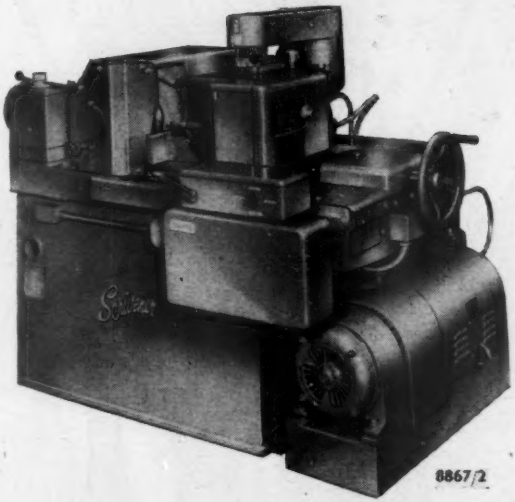

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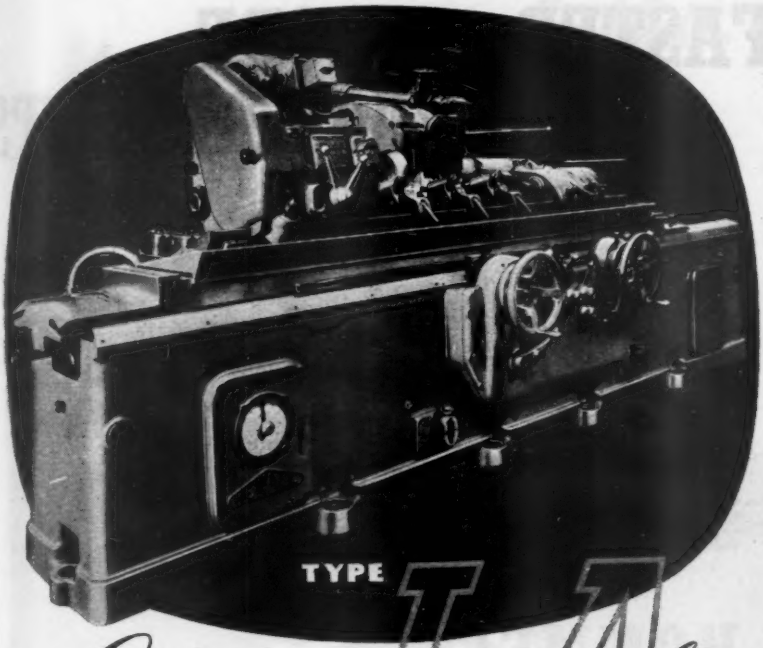
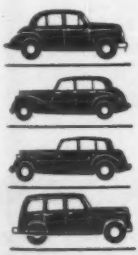


TYPE LA

Grinding machine

NEWALL "LA" GRINDER CAPACITY 16" x 60"



This Grinder, together with the LA Pin Grinder is being used extensively in the automobile industry today for the rapid production of crankshafts. These 2 machines make a complete production line for finished crankshaft production.

The LA Grinder is available in sizes 10" x 16", 24", 36", 48", 60", 72", 84".

We will be pleased to send full data on these and any other machines in the Newall range.

FASTER *and* MORE ACCURATE RESULTS

Height of Centre
6 5/16"

HOMMEL *UNIVERSAL DIVIDING HEAD*

The "Hommel" Universal Dividing Head will perform any circular or angular division of work (without any change being necessary) also machining straight as well as spiral and is applicable with spindle either Horizontal or Vertical.

The indexing mechanism is through a worm and wormwheel (no other gears are used) and is completely independent of the position of the work spindle, of the type and form of work and of the method employed.

The design and construction of the "Hommel" Head is such as to ensure easier and more accurate results without index plates, compound or differential indexing.

YOUR INSPECTION AT OUR SHOWROOMS IS INVITED

★ *Full particulars on request*

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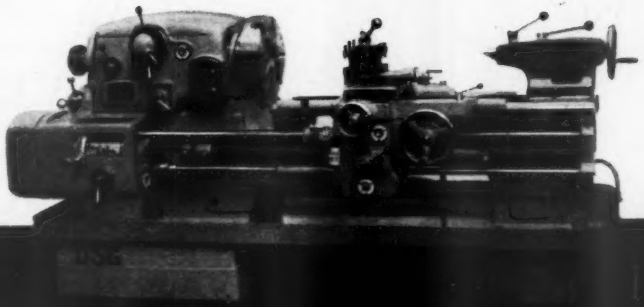
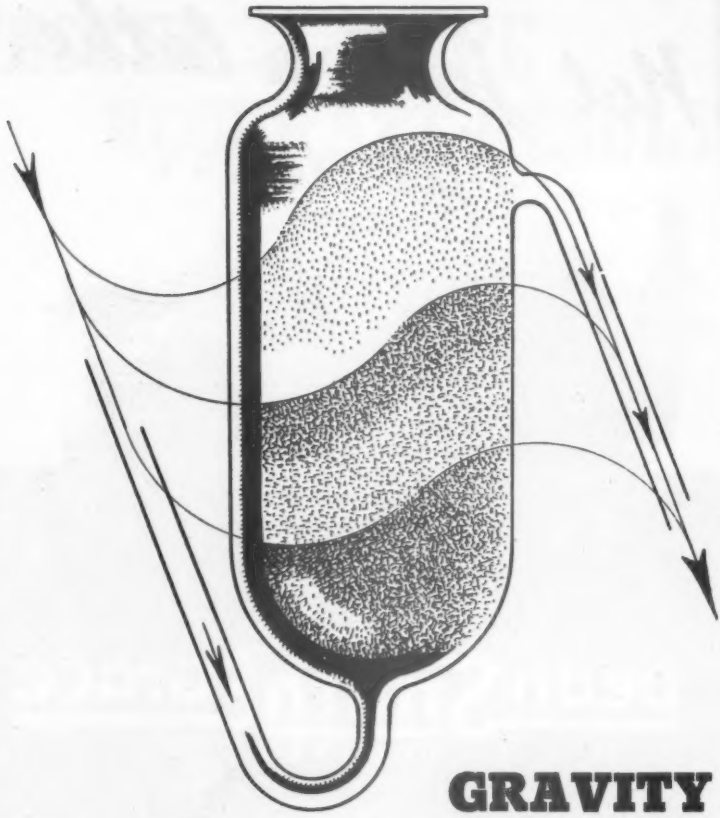
Not just a lathe, but a . . .



Dean Smith & Grace
LIMITED

LATHE

KEIGHLEY · ENGLAND



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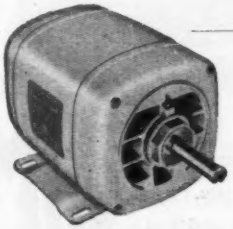
If the stage-manager forgot some vital 'prop'—a revolver, perhaps, or a telegram—the realism of the whole play would be shattered. In real life, too, it is service behind the scenes that can make or mar a production. That is why the Hoover F.H.P. Motor occupies so important a place in industry.

Manufacturers everywhere rely on this quiet, compact source of power. They have learned to trust the Hoover 'fractional' for quality, service, and dependability.



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It *remains* uniform with continued use and is good to the last drop—even after years of use.

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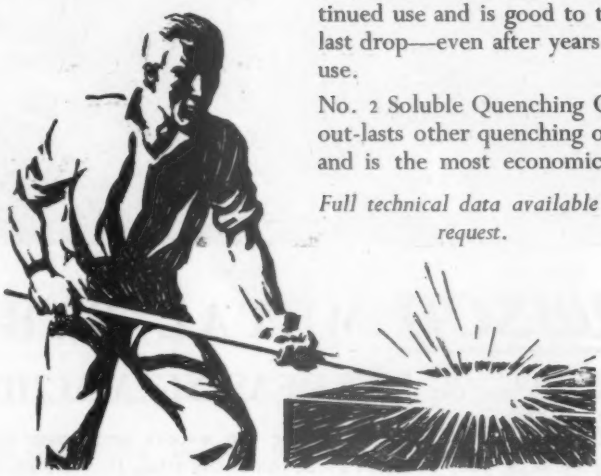

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Swing over bed 9"

Between centres 24" or 40"

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SHARPENS IRREGULARLY SPACED FLUTES

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WILL REMOVE BROKEN TAPS WITHOUT ANNEALING. SIMPLY DRILL OUT

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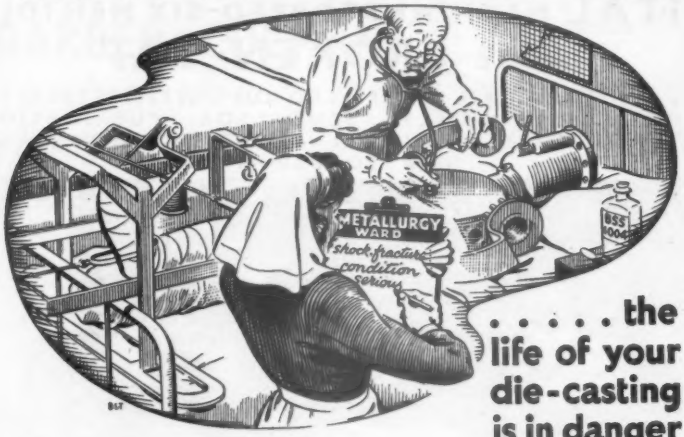

. . . . . the life of your die-casting is in danger

While we appreciate the necessity to recover every pound of the scarce non-ferrous metals, we cannot refrain from reminding users of high quality zinc alloy pressure die castings that the fact still remains that such castings can ONLY be produced by using alloys which conform strictly to B.S.S. 1004.

The present tendency to bring into use doubtful alloys makes it more necessary than ever for purchasers of zinc alloy pressure die castings to ensure that the pressure castings which they buy do in fact strictly conform to B.S.S. 1004.

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Whatever the problem (or the hundred and one problems) concerned with taking down, transportation, re-grouping and planning the layout of plant and machinery, then Thos. W. Ward's Factory Planning and Installation Department can be of service.

The whole of the resources of TWW plus the unique experience of FPI engineers ensures the acme of efficiency whenever such work has to be done. **No job is too big nor any job too small for TWWFPI.** Briefly, TWWFPI has the equipment, the transport, the personnel and the specialised know-how to tackle any problem of this kind. May we send you full details of the TWWFPI service?

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ask your moulder...

This is the fifth in a series of announcements designed to assist buyers in purchasing plastics moulded articles or components.

When a moulder talks about the 'finish' of his moulding, be sure that you know precisely what to expect. The types of finish applied to thermosetting plastics fall into two main categories:—

1. MOULD FINISH. In a mould finish, the surface finishing is confined to the removal of flash by careful filing or machining. Drilling and tapping or similar operations are performed, if necessary, but the actual surface finishing stops short at flash removal.

2. POLISH FINISH. In a polish finish, on the other hand, the entire exterior surface is grease mop polished to provide a lustrous appearance; this being additional to flashing and any necessary subsequent machining.

Small articles such as buttons and small closures are usually barrelled. This means that for mould finish they are put in quantity into a barrel and revolved for a period of time to remove the flash. For polish finish they are loaded into another barrel with the correct proportion of oil-impregnated wooden pegs and are barrelled mechanically to impart lustre.

There is all the difference in the world between these two standards of finish; so be sure to specify the exact type of finish you require.

For thermoplastic mouldings, buffing is not always necessary or desirable.

The surface finish of any moulding essentially depends on the precision with which the tool is made and the care taken in moulding. The chromium-plating of moulds greatly improves the finish and should invariably be specified.

Not all jobs may require a polish finish. Where it is not needed, price savings can be effected; but where it is necessary, make sure that your moulder is fully equipped to provide it.

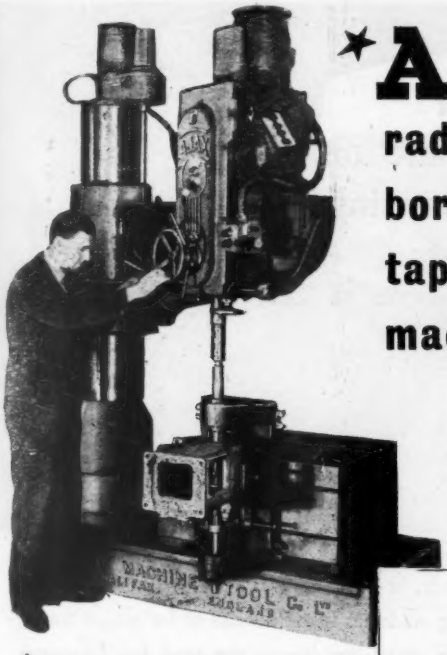
* *The illustration shows . . . Left, mop polishing and right, lathe filing in the finishing section of the works of The Streetly Manufacturing Co. Ltd. All thermosetting mouldings are submitted to the fullest appropriate finishing operations.*

If in doubt—ask STREETLY

The Streetly Manufacturing Co. Ltd. makes mouldings in thermosetting and thermoplastic materials and specialises in long runs of the highest quality mouldings. A high percentage of its regular output is of mouldings for manufacturers of electrical equipment and accessories. If you have a moulding job in view, call in Streetly for practical down-to-earth advice.

THE STREETLY MANUFACTURING COMPANY LIMITED
STREETLY, SUTTON COLDFIELD, Nr. BIRMINGHAM
TELEPHONE: STREETLY 78411. TELEGRAMS: BANG STREETLY

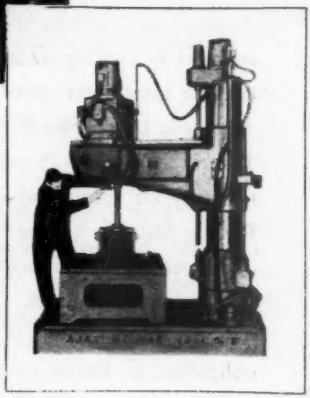
B·I·P



★AJAX

radial drilling, boring and tapping machine . . . .

Ajax 4' 6" machines Production boring and reaming in our own factory.



★ *Symbolical of Strength . . . .*

4ft. 6ins., 5ft. and 5ft. 6ins. sizes.
3ft., 3ft. 6ins. and 4ft. saddle traverses.
8 speeds in choice of 3 ranges.
4 rates of power feed at each speed.
1⅝in. dia. spindle with 14in. feed
3in. capacity in cast iron.
Completely electrified.
No friction clutches.

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Proprietors: Ada (Halifax) Ltd.

AJAX MACHINE TOOLS

"Sure, I can prove it, here's one way. In many Industries it is achieved by working machines faster instead of for longer hours; and the greater the speed the greater the need for Tecalemit Automatic Lubrication."

The result of over 25 years of experience has shown us the necessity for specialised systems for particular needs — from Rolling Mills to Sewing Machines. These systems have been developed to give the correct quantity of oil or grease at the correct interval of time.

A Tecalemit Engineer is at your disposal, entirely without obligation, to discuss your lubrication problems.

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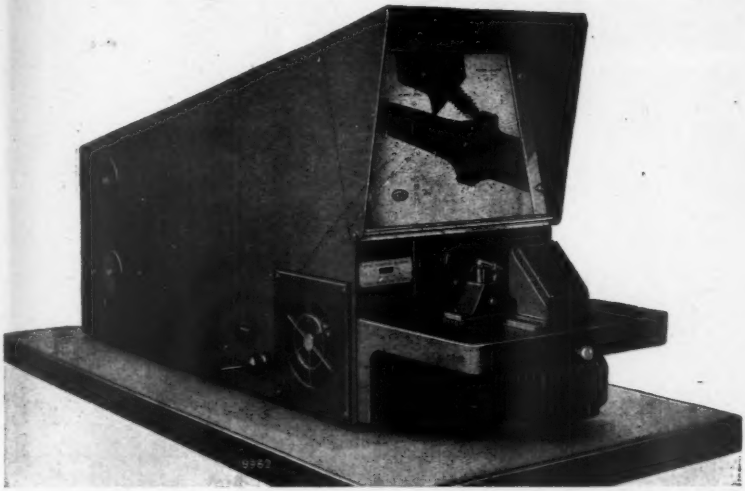

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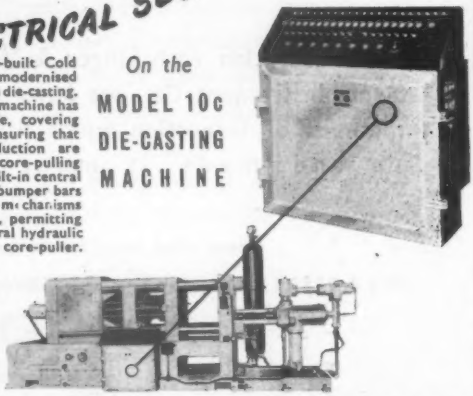
COMPLETE ELECTRICAL SEQUENCE CONTROL

(Patent applied for)

THIS New British-designed, British-built Cold Chamber Die-Casting Machine has modernised the technique of cold chamber pressure die-casting. The electrical control of the PECO machine has been approached from a new angle, covering every movement of the cycle, and ensuring that continuity and uniformity of production are maintained. The machine has four core-pulling connections, two for each platen, a built-in central hydraulic ejection cylinder and four bumper bars for mechanical ejection. All these mechanisms are fully interlocked and controlled, permitting operation in any sequence. The central hydraulic ejector may also be used as a core-puller.

On the

MODEL 10c
DIE-CASTING
MACHINE



Brief Details of Specification

Capacity—8½ lb. Aluminium
Pressure on Material—
6,150-23,000 lb. sq. in.
Locking Pressure—
450 tons (English)
Die Closing Stroke—14½ ins.
Die Space—14-25 ins. (Adjustable)
Platen Dimensions—35½ x 35 ins.

These features and many others are fully described in our brochure which we shall be pleased to forward to you on request.

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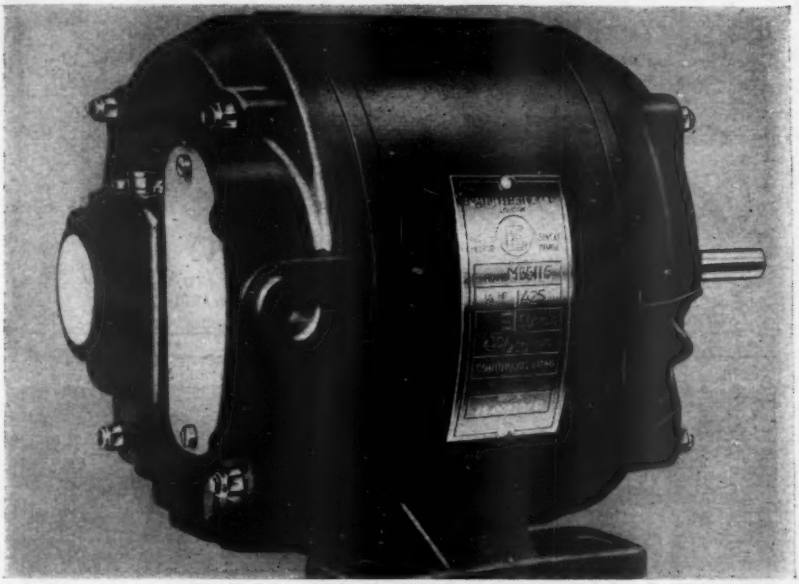
'ENGLISH ELECTRIC'

f.h.p. electric motors



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Fractional horse-power motors, A.C. and D.C., ranging from 1/12 h.p. to 1 h.p., are manufactured by 'ENGLISH ELECTRIC' for every type of drive.

They are suitable for a wide range of industrial, commercial and domestic applications and are made in a variety of enclosures which include drip-proof, totally-enclosed, and totally-enclosed externally fan-cooled, with ball or sleeve bearings.

The motor illustrated is a ¼ h.p. sleeve-bearing single-phase type.

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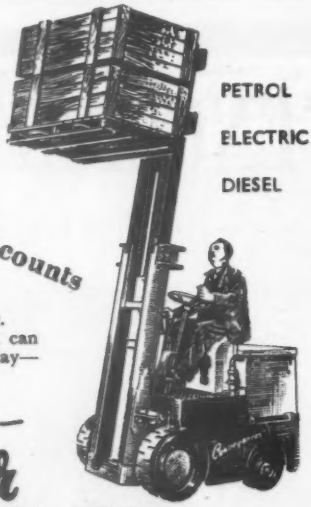
Works: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL

FHP.3

The invisible load—

is the one that counts



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The load which does not show in the production accounts is the high cost of moving materials by hand, which has been estimated at 15 to 85% of the total production cost. When one man and a CONVEYANCER can comfortably move 300 tons in a working day—

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Perfection in Planers

SWIFT LATHES are built as both Centre Lathes and Surfacing and Boring Lathes, and range from 17in. swing to 72in. swing, with any length desired between centres.
SWIFT-SUMMERSKILL PLANING MACHINES are built from 2ft. 0in. square up to 6ft. 0in. square, of any length of table up to 40ft. 0in., of both Double Column and Openside types, with either all Electric or reversing Two Belt Drive. Special All Electric Feed Motion.

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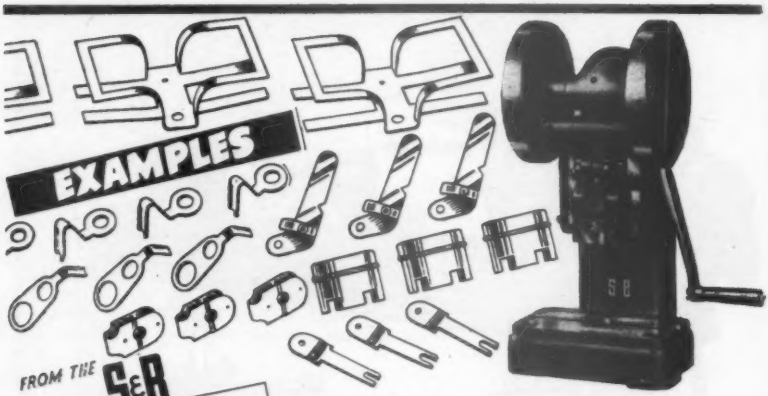

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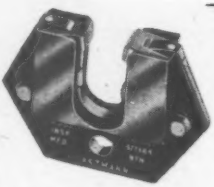
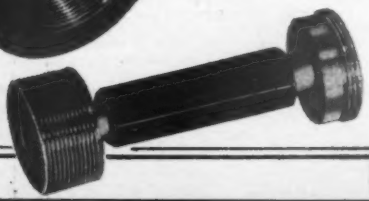
Rathbone

GAUGES of reliability HORSTMANN



Guaranteed for accuracy and precision



The comprehensive range covers Screw, Plain, Plug and Ring types, as well as the Horstmann patent adjustable Screw and Plain Caliper Gauges.

They are guaranteed for accuracy, finish and hardness to N.P.L. requirements and are in great demand.

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A full range is available.

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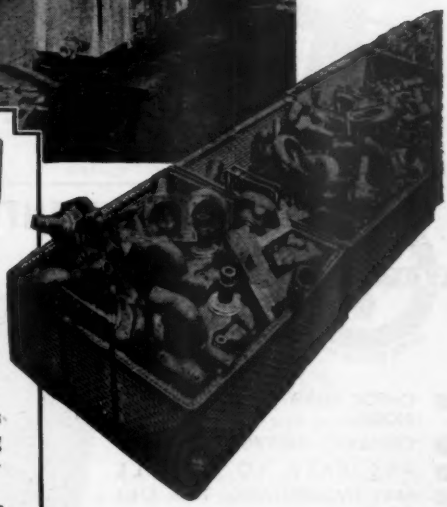
Each cleaning problem studied individually



Bratby

INDUSTRIAL CLEANING MACHINES

This illustration shows a machine cleaning crank cases in the production line.
It is equally capable of cleaning small parts in baskets.

Photographs by courtesy of "Machinery."

Sole Agents for Great Britain :
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They're BRIGHT

They're ACCURATE

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Our Works are organised to produce all sizes of Bolts up to 3", larger if necessary.

All enquiries receive immediate attention. Let us quote for your requirements.

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Improve Production!

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- COMBAT NERVOUS STRAIN
- ARE EASY TO INSTALL
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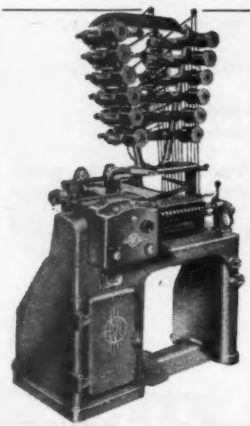
CURRENT: A.C. and D.C. 0 to 10 amps.
VOLTAGE: A.C. and D.C. 0 to 1,000 volts.
RESISTANCE: Up to 40 megohms.
CAPACITY: ·01 to 20 mFds.
AUDIO-FREQUENCY POWER OUTPUT: 0—2 watts.
DECIBELS: —25Db. to +16Db.

Various accessories are available for extending the wide ranges of measurements.

£19:10s.

Size: 8" × 7½" × 4½"
Weight 6½ lbs. *(including leads).*



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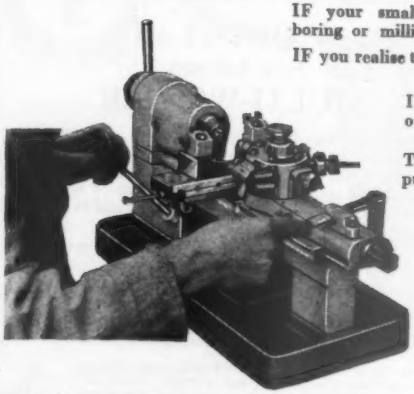

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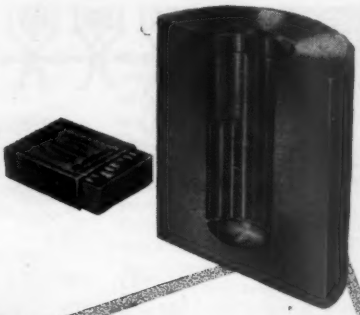

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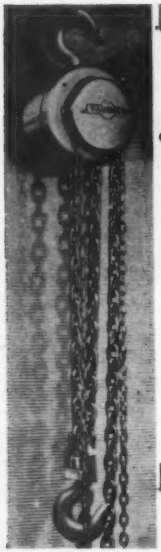

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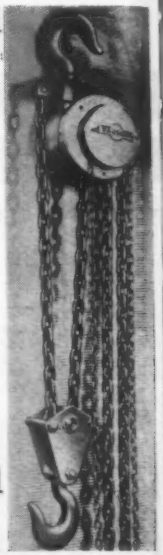

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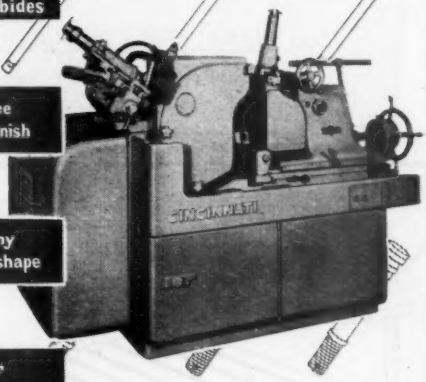

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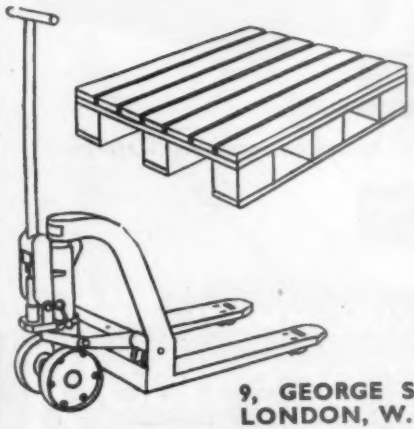

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STRENGTH: Good mechanical properties for stressed components.

STABILITY: Close tolerances are maintained throughout the life of the casting.

British Standard 1004

It is essential that alloys conforming to B.S. 1004 should be specified for all applications.

The Association welcomes enquiries about the use of zinc alloy die castings. Publications and a list of Members are available on request.

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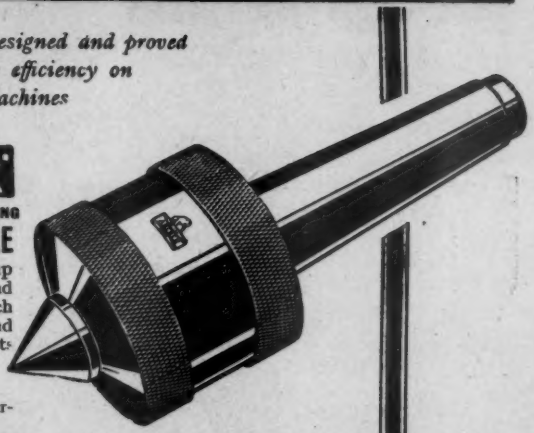

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